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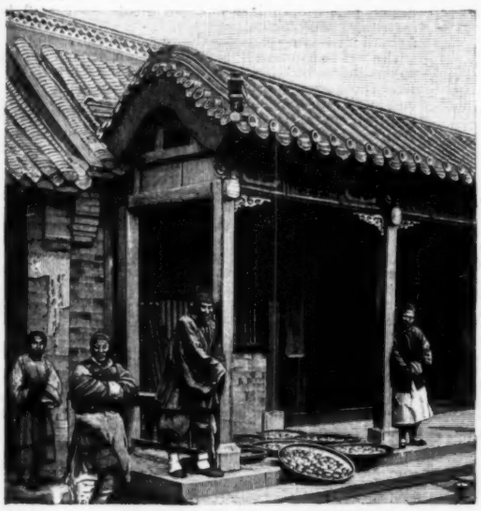
AN OLD TOWN IN SHANTUNG OCCUPIED BY THE GERMANS.

THE recent international complications in the Far East lend an interest to everything connected with China, and therefore we feel no hesitation in presenting to our readers to-day a number of views of Tsimo, an old town in Shantung, about twenty-eight miles north of the entrance to Kiaochou Bay, which was occupied for a time by German troops from H. M. S. "Prinzess Wilhelm," "Kaiser," and "Kaiserin Augusta," and finally by the First Company of the Battalion of Marine Infantry. The occupation of the place was short, for after the signing of the "lease" which ceded a small slice of the Chinese empire to Germany, this place, as well as the city of Kiaochou, was evacuated, although Tsimo remained for some time in the possession of the Germans.

One of the accompanying views gives an idea of the most characteristic feature of the main street of Tsimo, viz., the series of thirty or forty arches which are

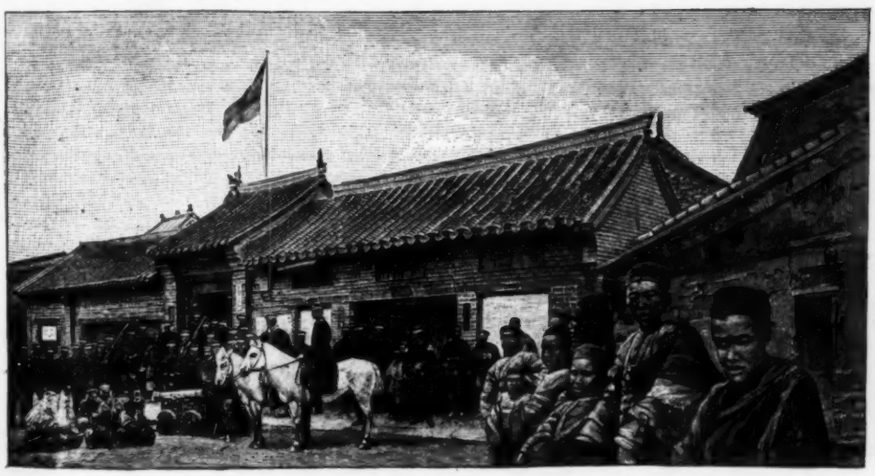
MAIN STREET, TSIMO.

PAGODA IN TSIMO.

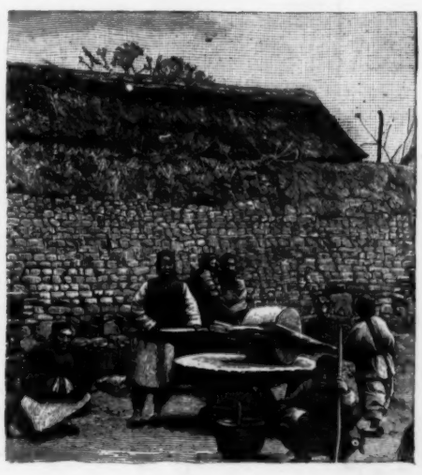


ENTRANCE TO A STORE IN TSIMO.

VIEW OF EASTERN PART OF TSIMO.



QUARTERS OF GERMAN MARINES IN TSIMO.



CHINESE MILL.

ILLUSTRATIONS OF TSIMO IN SHANTUNG.

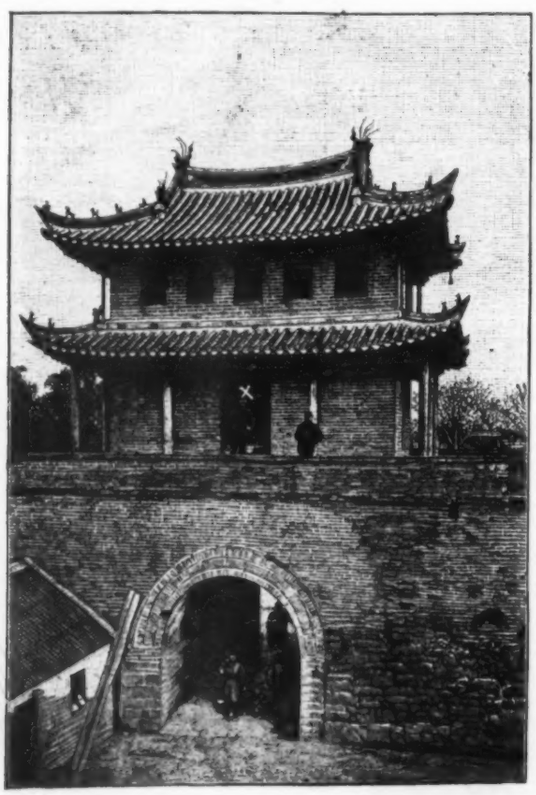
scattered throughout the length of the street, from gate to gate, a distance of about 2,624 feet. They were made of square stones and were built in memory of different individuals, such as a good mandarin, a faithful wife, an excellent mother, a brave soldier, or an upright judge, or, in some cases, favorite horse or mule. Many of these arches are covered with inscriptions, and some are well preserved, while others are falling in ruins. No one troubles himself about them,

INTERIOR OF THE GREAT TEMPLE IN TSIMO.

however, for several hundreds, or perhaps thousands, of years have passed since those in honor of whom they were erected were among the living.

Upon passing from these rough monuments to the interior of the largest temple in Tsimo, one is astonished at the richness of the decoration and the artistic execution of the wood carving, at the pictures and sculpture. Something of this is shown in one of our engravings. Another represents a temple on the city wall which is now used for the storage of war material. The crossed strips of paper on the front indicate to the Chinese that this is the property of the Emperor and is not to be molested. Some of the German soldiers made themselves comfortable in empty warehouses, and as the mandarin Tschu-Y-Chin did all in his power to comply with their wishes and demands, they had a much easier time than the under-officers, who were stationed on MaShan Mountain. The latter were left entirely to their own resources and were obliged to exercise the greatest vigilance in order that they should not be surprised by one of the night attacks of which the Chinese are so fond. Their only means of communication with their company was by signals, using Roman candles at night, and their only shelter the hastily built blockhouse.

From one of the other engravings we learn that the Chinaman of to-day grinds his ground nuts, sweet dried potatoes, etc., just as his ancestors did a thousand years ago. Everywhere in the villages one sees these stone rollers being moved over the stone bed by men or by blindfolded donkeys which are driven around in a circle. Such scenes as this bring forcibly to mind the utter lack of all progress in this, which claims to be the oldest civilized nation of the world. For the above data and the annexed engravings we are indebted to Ueber Land und Meer.



TEMPLE ON THE WALL OF TSIMO.

WESTERN SUBURB OF TSIMO.

ILLUSTRATIONS OF TSIMO IN SHANTUNG.

AUSTRALIAN DIAMONDS.

Although considerable numbers of diamonds are continually being found in Australia, chiefly in New South Wales, the true matrix has never been discovered. In that colony there is evidence in every case to show that the stones were drifted from their original matrix to the places where they were found, but up to the present its locale and nature remain unknown. When both have been ascertained, it is probable that New South Wales will become one of the leading diamond-producing countries of the world; but the work of prospecting is difficult, tedious, and costly, by reason of the mountainous character of the country in which gems are principally found. The finest stones yet known were obtained several years ago from the Cudgegong River, rising in the Australian Alps, and running through auriferous country in the northwestern portion of the colony.

No regular search is being made at the present time for the stones, the gold-mining industry being found of a more certain and remunerative character; but at Bingera and other portions of the New England district, in the northern portion of the colony, diamond mining is actively carried on, the stones generally being small, and many "off color." Others of the same kind are found at Inverell, in the same country. Not a few of the stones obtained at either place would be classed at first water by the expert, being white, clear, bright, and free from speck or flaw; but their extreme hardness makes the cost of cutting expensive in proportion to their size. Considerable numbers of diamonds from Bingera, Inverell, and other places are annually sold in Europe, the larger stones bringing good prices. Thus, a Bingera diamond which, when cut, weighed slightly under a carat was disposed of in London for £14 10s. 5d.; another with a greenish tinge, weighing over half a carat when cut, bringing £10. The stones averaged about four to the carat in their rough state, the prices realized being from 4s. 6d. to 8s. per carat. For diamond drills and similar industrial purposes, the New South Wales stones are simply invaluable, and are preferred to those of other diamond-producing countries. At Mittagong, between seventy and eighty miles south of Sydney, diamonds are found in a drift, associated with other gems. Some of the stones are of a much deeper tinge than the straw-color which makes them "off," and are regarded as having a peculiar beauty of their own as yellow diamonds.

In 1885 some good diamonds were found in one of the western gold districts, where some alluvial mining was being carried on, at a depth of from twenty to fifty feet. One of the stones, capable of being cut into a first-class brilliant of four carats, was sold for £75. Although diamonds are met with in numerous places in New South Wales, often many miles apart from each other, their sources remain undiscovered to this day. The abraded appearance of the stones generally shows that they must have traveled a considerable distance, although their extreme hardness has caused the signs of abrasion to be less conspicuous than in Brazilian and other diamonds. It is believed that the matrix of the Bingera and Inverell diamonds will be found somewhere near the Great Dividing Range, and that as it is approached the stones obtained will increase in size. The ancient river bed down which they were carried has yet to be discovered. An effort was recently made to sink on the "deep ground," but when the basalt had been pierced, and the under rock penetrated to a depth of one hundred feet, the death of the enterprising promoter stopped further operations. It is possible that they may be resumed in the near future, when, if successful, they will do much to enhance the reputation of New South Wales as a diamond-producing country.—Public Opinion (London).

A NOVEL COMMERCIAL SCHOOL.

In Genoa, writes the British consul in that town, there is a commercial school called "The Royal Higher School of Instruction in Commercial Studies." It is governed by a committee representing: 1, the ministry of agriculture, industry, and commerce; 2, the province; 3, the municipality; and 4, the Chamber of Commerce of Genoa. The complete course of instruction covers three years, and is divided into three classes of one year each, viz.: 1, commercial technology; 2, economical and juridical science; 3, literary and philological culture. Promotion from each annual class is by examination, and on the completion of the whole course a final examination has to be passed to entitle candidates to a diploma qualifying them to hold the highest posts of employment in banking and commercial establishments, or with the government, public companies, or others. Fees are $10 to compete for admission, $20 for admission to each class and $20 for the final diploma or degree. The total cost to a student successfully completing the course in three years is therefore $90. One interesting feature in the course of instruction is the "banco modello," or model office. Students in this department represent different firms in various parts of the world, and go through all the most minute operations of trading with each other, including transit of goods by sea and by land. Connected with these commercial houses are a deposit and discount bank, a bank of issue, and a clearing house, all being furnished with a complete supply of ledgers, forms, etc., such as are actually used in each department of trade.

Lord Charles Beresford is bound that Parliament shall know something about the navy. He took 200 members of the House of Commons to Portsmouth on a special train and made them inspect the dock yards, acting as guide himself.

KOONTEE, THE SEMINOLE BREAD ROOT.

By CHARLES H. COE.

KOONTEE or koonti is the common as well as the Seminole name for one of the most valuable and interesting vegetable productions of Florida, known to science as Zamia integrifolia. It belongs to the order Cycadaceae, and is the last native representative of the family in the United States. (There are other species of Cycads, however, in our hothouses, the so-called Sago Palm, Cycas revoluta, for instance.) A reasonably full description of this odd and long-neglected form will be appropriate in the present article.

FIG. 1.—TYPICAL SPECIMEN OF ZAMIA INTEGRIFOLIA.

Viewed from a distance, the koontee plant bears considerable resemblance to the fern, but on nearer approach it is quite palm-like; and in truth the genus to which it belongs is only slightly removed from the true palms. The several palm-like and evergreen leaves of the koontee are from two to four feet in length. The leaflets are from three to five inches long, lanceolate, roundish-obtuse at the outer end and attennate at the base, entire, parallel-veined, abruptly-pinnate and glossy. They are jointed to the upper edge of the leaf stem, which is round and tapering.

The root-like stem, or trunk, may be likened to a large, overgrown parsnip. The typical form of plants which have grown in the loose sandy soil of the pine lands is shown in Figs. 1 and 2. In the richer and stiffer hammock soils the stem is smaller and more bulbous, often having one or more branches; the growth of leaves is also more luxurious. (See Fig. 3.) The stem is buried in the ground, and in the typical specimens usually tapers to a tap-root several feet in length. It is so firmly rooted that considerable labor is required to dig it up. Sometimes the half-wild hogs succeed in partially uprooting the plant, which in time dies and turns white from exposure to sun and rain.

FIG. 2.—ZAMIA WITH WELL-DEVELOPED CONE—SCANT FOLIAGE.

FIG. 3.—BULBOUS FORM OF ZAMIA—FULL FOLIAGE.

Each branch of the stem produces a single so-called fruit, in the form of an oblong cone, about two and one-half by six inches in size, borne on a stout scape three to five inches in length. (See Fig. 2.) The exterior of the cone is marked by elongated hexagonal divisions, which form from seven to twelve rows, not unlike the rows in an ear of corn. In fact, the cone quite closely resembles a large, stubbed ear of dent corn, with enormous kernels, except the color, which is a dark, rusty brown. When the cone is fully matured, the divisions separate and the seeds drop out. These number from fifty to two hundred; they are about an inch in length, wedge-shaped, and bright scarlet.

Zamia integrifolia is indigenous to Florida and the West Indies. It was formerly distributed throughout most of the peninsula portion of the State, but is now mainly confined to the eastern coast, from latitude 29° southward. Specimens are occasionally seen in the woods and high hammocks of the coast sections of Volusia and Brevard counties, but the plant is and always has been more numerous in the extreme south than elsewhere. Its extinction in the northern part of the country was undoubtedly brought about by the Indians and the early white settlers, neither of whom probably thought of cultivating it so long as the woods contained a single specimen. In the south the conditions were different; a sparse population, together with a more congenial climate and soil, perhaps, has tended to its preservation. But even in this section, now rapidly becoming populated, it is only a question of a few years before this last member of the family will become extinct, unless steps are taken to prevent such an unfortunate ending.

A fine quality of starch or flour is made from the root, which it has long been claimed is fully equal to the best Bermuda and Jamaica arrowroot. Among the Seminoles it takes the place of wheat, in a climate where this cereal will not thrive; while the white residents in some sections use it in place of corn starch and other brands. The Indian method of manufacturing the starch is as follows:

After gathering and washing the roots, they are chopped into small pieces, and pounded to a pulp, in a mortar or trough cut for this purpose in a log. The mass is then removed and placed in a tub of water, where it is allowed to thoroughly macerate, after which it is strained through a coarse cloth. The fecula or starch passes through with the water, in the form of a fine paste, and is caught in a tub or deer hide, while the useless fiber is thrown away. When the starch has all settled, the water is carefully drained off, and the yellowish-white residue is removed and spread on a flat surface, such as the huge fronds of the cabbage palmetto, or a deer hide, where it is allowed to dry in the sun. A thorough drying leaves it ready for use. This method is improved upon by the whites, who generally grate or grind the roots, and repeatedly saturate and dry the product, which latter pains renders the starch a beautiful white color.

The principal use of koontee flour among the Seminoles is for making bread, which article (as made by them) has an orange or yellowish-white tinge, and a rather insipid taste, due mainly to the absence of salt. During the Seminole war, koontee flour was "the staff of life" to many of the white settlers as well as the Indians. Unlike the corn crop, it could always be depended upon, and it also possessed the added advantage of being ready for gathering at any season of the year, as the starch remains "stored up" in the stem. Large quantities, both crude and prepared, were found and destroyed by our troops on numerous occasions while scouting in the Everglades and west of the same in the big cypress swamp.

Some idea of the former consumption of this product, among our own race, may be had from the following facts. In 1845 a committee of the Territorial Legislature of Florida reported that "at least twenty-five thousand pounds" of prepared koontee had been made in south Florida during that year for shipment*—presumably to foreign markets via Key West. Two years previous a koontee mill had been erected on Biscayne Bay.† An earlier authority‡ also refers to large European shipments of koontee starch.

It seems strange, indeed, that this valuable substitute for wheat and arrowroot should have been neglected for such a length of time. It will grow on the poorest sandy soil, and with no more care than is required to plant the seed, or divide the branching trunks. No doubt careful cultivation would increase the size of the root, and perhaps add to the quality of the starch. It is unlikely that the koontee will survive very heavy frosts; however, a specimen grew for several years in a garden as far north as St. Mary's River, on the northern border of the State.

The plants from which the graphic illustrations were made grew on the property of Dr. J. M. Hawks, of Hawks Park, Volusia County, Florida, which gentleman kindly sent them to the writer for photographing and afterward for presentation to the United States Department of Agriculture. Mr. A. J. Pieters, of the Division of Botany, took the photographs, the first ever secured of this interesting Cycad.

HOW TO KEEP A FLOOR.

THE following are some valuable receipts given by Miss Cornelia C. Bedford, in her course of lectures on domestic science before the Brooklyn Institute:

ROUGH FLOORS WITH WIDE CRACKS.

1. Make a paste with rye flour of the consistency of a drop batter; to each gallon of this add one-quarter of a pound of cheap glue which has been soaked and then set over hot water until dissolved. Mix well and put a thick coating over the entire floor. Put on carefully; when dry, if necessary, add a second coat and let that dry. If the cracks are wide, sift about a quart of plaster of Paris to each gallon of the first lot of paste, adding it to the paste when cold, and then applying at once. When both coats are on and thoroughly dry, the floor may be covered with one or two thicknesses of thick manila paper pasted on; when this is dry, a coat of any good pattern of cheap wall paper follows, and with one or two coats of varnish it will last for years, and is very easily cleaned; also it aids greatly in keeping out the cold.

2. To one pound of cheap flour add three quarts of water and one tablespoonful of ground alum and use as above after it has been well boiled.

3. Tear newspapers into bits, soak them overnight in cold water, then boil for three or four hours, stirring and beating to disintegrate the fiber. It should be about the consistence of a very thick pour batter. To each gallon of this take one pound of flour mixed with cold water to a paste and one-quarter of a pound of glue, soaked and dissolved, and two tablespoonfuls of ground alum. Boil together for ten minutes and apply; if for deep cracks, cool and add some plaster of Paris and apply quickly.

STAINS FOR FLOORS.

1. One gallon linseed oil, 1 pound Spanish brown, 2 pounds powdered senna, 1 ounce litharge. Mix in an old tin pan, heat carefully to the boiling point, take from fire, add 1 pint turpentine, and apply with a broad brush. Choose a clear dry day and open doors and windows. Next day polish with a waxed cloth wrapped round a block which is fastened to a broom handle.

2. One peck red oak bark, 2 pounds common tobacco, 1 tablespoonful copperas. Boil bark and tobacco in 2 gallons of water. When well colored stir in the copperas. Apply, after straining, with a broad brush, and when dry mop with weak lye water. Good for common floors.

3. Dark Mahogany Color.—Boil half a pound of madder and 2 ounces of logwood in 1 gallon of water for an hour. Strain, and apply while hot. When dry go over with a solution of 2 drachms of pearlash in 1 quart of water.

To Remove Grease from Waxed Floors.—Cover with turpentine for an hour or two. Cover with powdered talc and press with a warm iron. Brush off talc; if spot has disappeared, rub with wax; if not, repeat process.

Ink Spots on Floors.—Rub with sand wet with equal parts of water and oil of vitriol; when ink is removed, rinse with weak lye water. In place of oilcloth, tack down an old Brussels carpet wrong side up; give it two coats of paint, and when thoroughly dry varnish.

To Remove Grease from Matting.—Wet a nail brush in slightly salted water, rub on castile soap, and scrub the place. Have the water boiling. Continue to scrub with soap till the spot disappears. Wash with

* Senate Report, 242, 1st Ses., 30th U. S. Cong.

† St. Augustine News, December 30, 1843.

‡ Romans' History of Florida, 1775.

clean cloth and rub dry. Always rub lengthwise the grain.

FOR AN OLD GREASY FLOOR.

Scrub well with soap and sand, then with ammonia water. Fill cracks around baseboard or between strips with putty or paper pulp. Apply shellac or prepared house paint; if the latter, use varnish after the second coat is thoroughly dry. Rub lightly with crude oil or a very little kerosene once a week or fortnight.

In staining, dilute ready-made paints with about two-thirds turpentine. This will sink into porous wood and dry immediately. The more turpentine used, the lighter the color. If hard wood, give two coats, if soft wood, three or four. Follow the last coat with a rubbing with hard oil (boiled oil).

To give a good color to a pine floor, wash in a solution of one pound of copperas dissolved in one gallon of strong lye.

IMPROVED RADIOGRAPHIC APPARATUS.

THE continual improvements in the technique of Roentgen rays have happily resulted in a constantly increasing use of Roentgen photography and radiography, both in medicine and surgery. Were we to summarize the results obtained, we should have the following list:

1. Considerable shortening of the time of exposure by using improved spark coils and Roentgen tubes, and by using fluorescent screens.

2. The production of pictures richer in contrast than hitherto, obtained by excluding stray Roentgen rays; and,

3. Improvements in the apparatus employed to effect a more ready means of manipulation and greater transportability.

For the production of good Roentgen photographs, as well as for rendering the interior of the thorax and pelvis visible, an efficient spark coil and a good Roentgen tube are prime requisites. Since Roentgen rays were first discovered, spark coils have been vastly improved. Max Kohl, of Chemnitz, who for twenty-two years has made a specialty of constructing induction coils, has succeeded in bringing his instruments to the highest plane of perfection. Even when the current is interrupted 1,500 to 1,800 times in a minute, these new coils of Kohl give sparks of the maximum length at each interruption. The current is broken by a vibratory interrupter, illustrated in Fig. 1. A small electric motor is made to dip a platinum pencil in a glass vessel partially filled with mercury, and then to withdraw it again. Petroleum is poured over the mercury and is prevented from being hurled out by the form of the receptacle. The electric motor is connected with a tachometer, which indicates the number of interruptions made in each minute, thus dispensing with the use of a watch. The pointer of the tachometer places itself over that numeral on the dial which corresponds to the number of interruptions. A glance at the dial, therefore, suffices to show whether the desired number of interruptions are being made. It is only by this arrangement that it has been made possible to determine accurately the number of interruptions, whereas, in other interrupters, recourse must be had to guessing and to rough calculations. By means of a current regulator, the interruptions may be made as rapidly or as slowly as possible. By using an adjusting screw, the mercury vessel may be raised or lowered while the instrument is in operation.

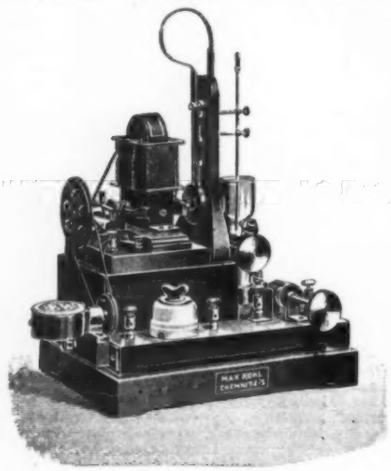


FIG. 1.—INTERRUPTER.

The induction coils (Fig. 2) are constructed with most elaborate care. They have a very long primary coil, which increases the efficiency of the instrument and lessens the strength of the operating current. The secondary coil is carefully insulated and can readily withstand the great tension of 150,000 to 300,000 volts produced in large induction coils. The primary coil is inclosed in a peculiar vulcanized rubber tube, and can be readily removed from the secondary coil. The secondary coil, moreover, is not fastened directly to the condenser, but is mounted on two wooden supports. By this arrangement the coil has become readily transportable. The induction coil can be connected with any convenient direct current lighting circuit, but when such a connection cannot be made, portable storage batteries must be employed. These batteries, however, require charging only at intervals of several weeks, and are built in wooden boxes lined with rubber to guard against breakage. They can be sent charged to any distance whatever. Since no acid vapors are developed and but little room is taken up, these batteries can be stored in almost any place. The charging, moreover, can be effected by using a thermopile, which can be kept in operation day and night uninterruptedly, without any supervision.

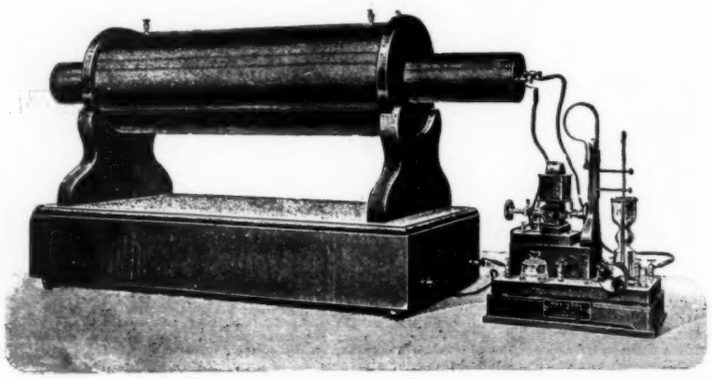


FIG. 2.—A TWO-FOOT SPARK INDUCTION COIL CONNECTED WITH AN INTERRUPTER.

The new Roentgen tubes are characterized by their efficiency and durability. When we consider that a hand or foot requires an exposure of only 20 to 40 seconds, an arm or thigh but 40 to 60 seconds, a thorax 1¼ to 1½ minutes, and a pelvis only 2 to 4 minutes, it is evident that a good Roentgen tube can be used for several dozen pictures before it becomes useless. The times of exposure here given are to be understood as having been obtained with an induction coil yielding a spark of 9¾ to 11¾ inches in length and with Schleusner plates unprovided with fluorescent backing.

The fluorescent backing used consists of a screen made of carbon leaves and coated upon one side with a uniform layer of calcium tungstate. The screen is placed with its coated side against the emulsion of the photographic plate, and by reason of its fluorescent properties considerably increases the effect of the rays on the plate. By using dry plates coated on both sides and placed between two fluorescent screens, the pelvis of a man of average size can be photographed in 2 minutes, whereas formerly 45 minutes' exposure was required to produce a negative poor in contrast and in definition. It is well known that in photographing the stouter portions of the human body, exposures are required unproportionately long compared with those required for thinner parts. One of the reasons for this phenomenon lies in the fact that Roentgen rays are strongly diffused by all substances, even by the particles of dust in the air. This diffusion is particularly strong in human flesh. Each portion of flesh illuminated by the Roentgen rays in turn illuminates the entire photographic plate, and for this reason photographs of the pelvis are lacking in contrast. In order to avoid this difficulty, only so much of the flesh under treatment should be illuminated by the Roentgen rays as appears absolutely necessary, in order fully to cover the plate. Let us assume the tube to be 23 inches from the plate, then it is evident that at a distance of 11½ inches from the tube the leaden screen used would require an aperture but one-half the size of the photographic plate to allow the cone of rays to act on the plate.

Max Kohl, according to Dr. Walther, of the government physical laboratory of Hamburg, has made a leaden box which is designed to shut out unnecessary rays. The box is 31½ inches long, 11⅞ inches high, and has two semicircular recesses to enable a person to be laid comfortably thereunder. The interior surface of the box is completely lined with sheet lead 0·078 inch in thickness. The bottom consists of a heavy level board also covered with sheet lead. By using sheet

FIG. 4.—A COMPLETELY EQUIPPED ROENTGEN TABLE.

FIG. 3.—LEADEN BOX WITH SCREENS.

lead in such abundance, the rays reflected by the operating table are almost entirely excluded. In the cover of the box is a rectangular opening 15⅞ by 15⅞ inches. Over this opening, corresponding to plates 11·7 by 15·6 inches and 13·6 by 19·5 inches in size, leaden screens are laid having openings 5·8 by 7·8 inches square and 7·8 by 9·7 inches square.

In Roentgen tubes of greater power, not only the platinum used, but also the entire tube, sends forth rays which cross the rays coming from the platinum, thus producing negatives lacking in definition. To shut off these rays a second leaden screen is mounted on two supports above the aperture in the first leaden screen. An opening is made in the screen of such size that the cone of rays coming from the platinum shall not be crossed. In photographing with this apparatus, plates coated on both sides, or better still, films placed in a plate-holder between fluorescent screens, should be used. To shut off the rays reflected by the plate-holder, a leaden lining is employed. In order to render the manipulation of Roentgen apparatus as easy as possible for the practical surgeon, Kohl has grouped the various parts on a movable table, as shown in Fig. 4. This table on its upper portion carries the spark coil, the interrupter, the current regulating devices, and measuring instruments. On the lower platform the storage batteries are carried. The manipulation by means of this arrangement has been considerably simplified.

In their practical application Roentgen rays are no longer used exclusively for setting bones or for locating foreign bodies, for it has been determined that they also have a healing effect in cases of lupus—an effect characterized by the production of very smooth scars with but little disfigurement of the features. Recently gout and rheumatism have been treated with Roentgen rays, and the results are very encouraging. Experiments are being made to determine the effect which the rays have on bacteria, but no definite conclusions can as yet be drawn. As a whole, the results obtained since Roentgen first made his brilliant discovery have been very beneficial for suffering humanity.—Illustrirte Zeitung.

ELECTRIC PROPULSION AT PARIS.

AN interesting application of electric propulsion has just been made at Paris by the French Thomson-Houston Company upon the tramway lines of Place de Republique of Aubervilliers and at Pantin. In Paris the tramways operate through accumulators and externally through overhead trolley. The two lines just mentioned have a total length in Paris of 3¾ and 4 miles. The length outside of the city walls is 1 mile and 1¼ miles. There exist likewise three other lines, which do duty for various villages at the gates of the city.

The track was laid by the Paris and Department of the Seine Tramway Company, and consists of Broca grooved rails weighing about 30 pounds to the running foot in the middle of the roadway, and of Vignole rails where it approaches the sidewalks. The cars employed (Fig. 3) are large coaches with seats on the roof. They are capable of carrying 56 passengers—4 upon the platform, 24 in the interior, and 28 upon the roof. Contrary to what happens almost everywhere, they may be criticised as being too capacious. In order to assure a proper service, it is preferable to use small cars and run them at short intervals. Let us add that the present cars, apart from this, comprise a whole series of improved apparatus. They rest upon trucks jointed in front and behind that permit of utilizing adhesion upon the two driving axles.

The cars are perfectly symmetrical in front and behind, and so it is unnecessary to turn them around at the terminal points of the line. At the upper part is the trolley pole, which is fixed in a groove in order to permit of the passage beneath the railway bridges of the city.

Each driving axle is actuated by a 25 horse power electric motor. The controllers that are used for the coupling and maneuvering of the various apparatus are placed upon the front and rear platforms. We must not forget to mention that each car is provided with sand boxes for spreading sand upon the tracks when necessary, and with ordinary brakes and electromagnetic ones on each axle. These latter have permitted of stopping, within less than 50 feet, a car carrying 4·4 tons, upon a gradient of three-tenths of an inch to the foot at a speed of 12 miles an hour.

The accumulators, which are those of the Société pour le Travail Electrique des Metaux, are 224 in number, with seven-plate elements of a capacity of 35 amperes-hour. The plates, which are 12 inches in height and 3 in width, are inclosed in ebonite boxes. The box that contains the battery, and which is placed under the car (Fig. 3), is 5·6 feet in length, 6·5 in width, and 2 in height. The electric equipment of each car, upon which we cannot dwell here, permits of sending to each the current from the trolley, or that from the accumulators, or the current from the trolley for actuating the car and at the same time charging the battery of accumulators. Each car is lighted with ten 16-candle-incandescent lamps.

The electric works that furnishes the necessary energy is at the depot of Aubervilliers. It is divided into two principal parts. On one side is the boiler room, the engine room, and the shop for repairing the accumulators, and on the other are the tracks for the cars not in use, with arrangements for thorough inspection. The boiler room contains three Roser multitubular boilers of a heating surface of 2,200 square feet. These boilers are placed below the surface. The coal coming in at the surface is emptied through hoppers into cars.

In the engine room, which is situated back of the boiler room and parallel with it, there are three single cylinder horizontal expansion engines of the Corliss type, of 250 horse power and 75 revolutions per minute. Each of them, through a belt, actuates a 6-pole Thomson-Houston dynamo of 150 kilowatts and 550 volts, at 400 revolutions a minute. They were constructed by the Postel-Vinay establishment. These apparatus are capable likewise of operating as shunt dynamos at 575 volts for charging accumulators. Two main circuits start from the distributing board, one at 530 volts for supplying the trolley and the other at 575 volts for charging the way stations. The feeders are capable of being branched one upon the other at will.

Such are the principal arrangements of a new installation of mixed propulsion by accumulators and an overhead trolley, which seems to us to fully respond to the present exigencies of travel in Paris.

For the above particulars and the illustrations we are indebted to La Nature.

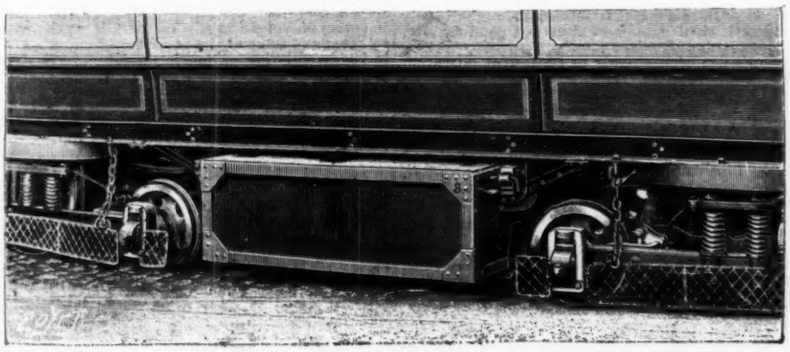


FIG. 1.—VIEW OF THE TRUCKS UPON WHICH THE CARS REST. THE BATTERY OF ACCUMULATORS IS PLACED IN THE MIDDLE.

FIG. 2.—BOX CONTAINING THE ACCUMULATORS.

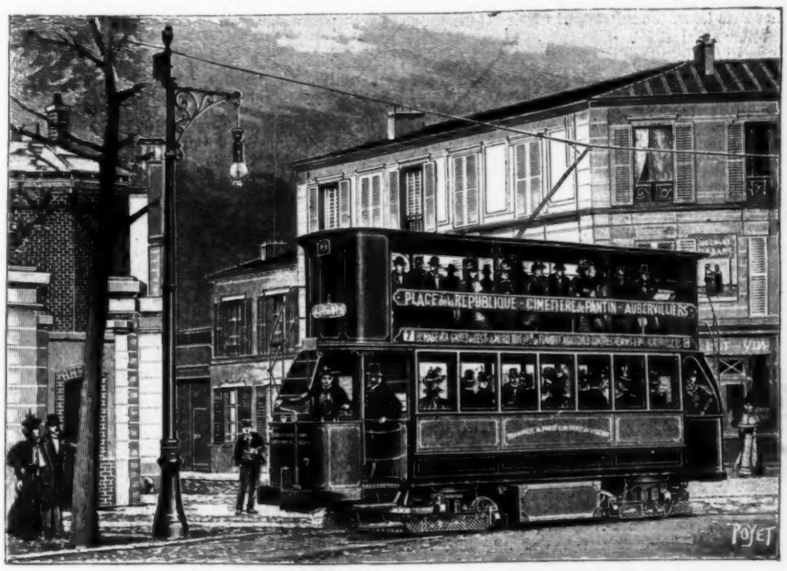


FIG. 3.—VIEW OF A CAR AND OVERHEAD TROLLEY.

ALUMINUM AS A RIVAL OF COPPER AND BRASS FOR ELECTRICAL CONDUCTORS.

By ALFRED E. HUNT, S.B., in The Aluminum World.

COPPER has been used for electrical conductors very largely in the past, due to its comparatively high electrical conductivity, power of withstanding corrosion, ease of soldering and brazing, malleability, tensile strength, and ductility. The exceptions in the past have been in telegraph wires of soft wrought iron and the brass, iron, and steel used in the parts of electrical machinery.

Aluminum has already been used successfully for the purpose, and this article is written to call attention to its comparative merits as an electrical conductor.

The following facts regarding the metals copper and aluminum, in bars, rods, and wire suitable for electrical conductors, need first to be considered:

Copper has a specific gravity of 8·93 (Authority—Association of Copper Manufacturers of the United States, 1893); an electrical conductivity, when pure and soft annealed, reckoned at 100 in the Matthiessen scale, but as ordinarily used in electrical conductors of about 98—97·61 (Authority—Prof. W. C. Roberts-Austen); a tensile strength of from 16,500 pounds per square inch in soft annealed pure copper (Authority—Carnegie's Hand Book) to 65,000 per square inch in hard drawn bars; and a selling price of about fourteen cents per pound in the United States, and an equivalent selling price of 130 marks per 100 kilogrammes in Germany, for wire, bars, and rods such as are used for electrical conductors.

Aluminum has a specific gravity of 2·68; an electrical conductivity (commercially pure metal) of 63·00 (Authorities—Chas. F. Scott, of the Westinghouse Electric Company, and Prof. Jos. W. Richards, of Lehigh University); a tensile strength in pure soft wire of 26,000 pounds per square inch, and in hard drawn rods or wire of 40,000 pounds per square inch.

Special selling price: The firm of Aron Hirsch & Son, of Halberstadt, Germany, are ready to sell aluminum conductors in the form of rods, bars, plates, and wire drawn to 2½ millimeters in diameter, at the special low rate of 280 marks per hundred kilogrammes, for large quantities of metal, and similarly the Pittsburg Reduction Company will sell rods, bars, plates, and wire drawn down to No. 12 Brown & Sharpe gage (eight hundredths of an inch diameter), in large special orders for electrical conductors, at the rate of twenty-nine cents per pound at their works in the United States.

These prices are special rates, below the regular prices for aluminum which these concerns have decided to make for electrical conductors alone, in order to favor the introduction of aluminum for this purpose and to overcome the handicap which aluminum has occasioned by its lower electrical conductivity than copper, in the matter of special low relative prices.

From these facts it is evident that:

1. Any given volume of copper is 3·332 times heavier than an equal volume of aluminum.

2. The equivalent price of fourteen cents per pound for copper for any length of any equivalent section of aluminum wire or bar would be 14 cents times the factor 3·332, or 46·65 cents per pound. That is, one thousand feet of wire of, say, one-tenth inch diameter would cost equally as much if bought of copper at 14 cents per pound or aluminum at 46·65 cents per pound. Aluminum, therefore, sold at 29 cents per pound is only about 62 per cent. of the cost of copper at 14 cents per pound, section for section.

3. Reckoning the copper conductor to have its maximum of 100 per cent. conductivity, and the aluminum to have a conductivity of 63 per cent. (which the Pittsburg Reduction Company are ready to guarantee for their special pure aluminum metal for electrical conductors), then for an equivalent electrical conductivity a given section of copper that can be placed at 100 should be increased in area in round numbers to 160 to give an equal conductivity.

4. Due to their relative specific gravities, the weight of the given equal length of the aluminum conductor with 160 sectional area will be only forty eight per cent. of the weight of the copper conductor with sectional area of 100 having the same electrical conductivity.

$100 \times 8{\cdot}93 = 893$, weight of the copper.

$160 \times 2{\cdot}68 = 428{\cdot}8$, weight of the aluminum.

$\frac{428{\cdot}8}{893} = 48$ per cent.

5. As to their relative cost for electrical conductors of equal conductivity, aluminum at twenty-nine cents per pound is the most economical conductor as compared with copper at fourteen cents per pound.

Taking as an illustration an aluminum conductor to replace a copper wire of No. 10 B. & S. gage (about one-tenth of an inch diameter), the aluminum wire of equal, in fact somewhat superior, electrical conductivity would be of No. 8 B. & S. gage (slightly over one-eighth of an inch in diameter).

The weight of a mile of No. 10 copper wire is 162·32 pounds; and its cost at 14 cents per pound would be equal to $22.72.

The weight of a mile of No. 8 aluminum wire would be 79·46 pounds and at 29 cents per pound would cost $23.04.

Forty-eight per cent. of the weight of the No. 10 copper wire, which will give equal electric conductivity in aluminum wire, would only weigh 77·91 pounds; so that more accurately, $22.59 would be the cost of a mile of aluminum wire at 29 cents per pound to replace a mile of No. 10 copper wire at 14 cents per pound, costing $22.72.

6. The Continental requirements in tensile strength for soft copper wire, rods, and bars used as electrical conductors is twenty-two kilogrammes per square millimeter; the English requirement being similarly fourteen tons per square inch; and our American requirement is about its equivalent of 32,000 pounds per square inch.

Aluminum wire, rods, and bars will be furnished of 63 per cent. electrical conductivity, which will have an equal tensile strength per unit of area with the copper, and therefore with the electrical conductivity equivalent of forty-eight per cent. of the weight of the copper and sectional area of 160 against the area of the copper section 100, the tensile strength of the aluminum conductors will be as 100 for the copper is to 160 for the aluminum. This would mean if a square inch of copper conductor was used of, say, 32,000 pounds per square inch tensile strength, the equal conductivity area of 1·6 inches of aluminum would have a tensile strength of 51,200 pounds.

It has been already determined that with aerial lines, the snow and ice load is practically as heavy on length of small wire as upon larger sections, so that no objection upon this score can probably be found to the use of the larger sections of aluminum wire.

Both on account of having 48 per cent. of the weight and on account of having about 60 per cent. more strength, the aluminum conductor could be used in much longer spans between supports, and the number of expensive poles and insulators can be materially diminished. Properly drawn aluminum wire is as tough and will stand bending as severely without breaking as soft copper wire. The toughness of aluminum wire is, however, greatly modified by the care and skill used in manufacture. If it is drawn too severely through the dies or is not well annealed at the proper intervals in the drawing operation, it is finished much more brittle than when properly manipulated.

Hard drawn copper wire, especially that in the smaller sections drawn through diamond dies, is furnished with a tensile strength of 65,000 pounds per square inch. What the maximum tensile strength of the best pure hard drawn aluminum will reach under similar favorable conditions for developing the maximum tensile results has not yet been determined, but from experiments already made it can quite surely be predicted that at least 50,000 pounds per square inch can be obtained, and perhaps even higher strength still.

Aluminum hardened with a few per cent. of alloying ingredients can be furnished in wire with a tensile strength far in excess of what can be obtained in pure aluminum. Experiments are now being made by the Pittsburg Reduction Company, to determine just what alloy will furnish the maximum tensile strength, together with maximum electric conductivity. From results already obtained, it can surely be predicted that an alloy of aluminum can be furnished which drawn into wire will have a tensile strength of at least 65,000 pounds per square inch and electrical conductivity of more than 50 in the Matthiessen scale. This material to rival hard drawn copper wire and the silicon bronze materials which are now in use, where maximum tensile strength together with good electrical conductivity are required.

The power of withstanding corrosion is greatly in favor of aluminum as an electric conductor over copper. Copper does not change in dry air, but in moist air it becomes covered with a green layer of basic carbonate of copper, which itself has a corroding action and does not coat and protect the underlying copper from further corrosion. Ammonia in contact with copper absorbs oxygen and the copper dissolved in consequence of the formation of a soluble cupric oxide and ammonia. This action is especially a source of trouble where copper wire is used in connecting rail joints in the tracks of electrical railroads where the ground is often subjected to ammoniacal solutions.

Aluminum similarly is not acted upon in dry air and the corrosion in moist air is of the oxide of aluminum, alumina, a harmless salt which forms an impenetrable coating on the metal and protects it from further corrosion to a considerable extent. Ammonia solutions act on aluminum only upon the surface, attacking it and leaving behind a more resisting surface coating of a brown color containing silicon, which resists corrosion from dilute mineral acids and dilute solutions of organic acids as well as moist and dry air. Subject to sulphur gases such as locomotive flue gases, aluminum withstands corrosion better than copper.

If kept free from galvanic action with any other metals, electro negative to itself, aluminum is far less easily corroded than copper.

The difficulty of soldering or brazing aluminum is the chief drawback to its use as an electrical conductor. Aluminum can be soldered strongly, but it is a more difficult and slow operation at best as compared with copper, and there is much more rapid weakening of the soldered joint, due to galvanic action between aluminum and the metals of the solder, than with the less electro positive metal, copper.

In many places the aluminum can be first coated with copper and the soldering or brazing operation made on the copper surfaces thus formed.

Several forms of joints have been successfully used to avoid the necessity of soldering; the best forms being to use thin aluminum sheets to wrap the joints and to twist or otherwise bind with the aluminum bars or wires to be joined. These wrapped and twisted joints with aluminum sheets can be left smooth on the outside when desired, can be made much stronger than the body of the conductors, and are really a more serviceable job than soldered or brazed work in many cases with copper. One very practical way of making joints of aluminum wire is to roll the thin aluminum sheet of about six inches width into two cylinders from opposite edges of the sheet. These double cylinders are very cheaply made on mandrels in a lathe. The ends of the wires to be joined are inserted in these cylinders from opposite ends and both the wire and the sheet twisted with pliers until a firm joint is secured, much stronger than the body of the wire. The joint can readily be made impervious to the air and moisture.

The C. McIntyre Company, of Newark, N. J., have a patented joint which is made very much along the lines of this joint. Information regarding their patented form of joint can be obtained by correspondence with them as above. Also the American Electric Fuse Company, Chicago, Ill., make a very satisfactory joint.

Another disadvantage which handicaps aluminum in special uses for electrical conductors will be where the material has to be insulated that the cost of insulation will be approximately one-third greater for the larger section required in aluminum over the cost for the smaller section of copper required for the given conductors; and where aluminum is to economically compete for insulated conductors, the price of the aluminum will have to be further reduced to meet this contingency.

Aluminum is soon to be placed in an extensive line of conductors, where this added extra cost of insulation will be determined by actual fabrication, the Pittsburg Reduction Company, in this particular case, agreeing to pay the added costs, in order that actual experience may be gained as to their relative amounts.

There are certain places where aluminum will be at a disadvantage over the smaller section of equal conductivity of copper, in ducts or conduits, where space is a considerable item. In such cases, the use of aluminum would necessarily be prevented.

An ample field for the employment of aluminum for some time to come, however, seems open at the present time for bare transmission lines, especially for high potential long distance work, and for long distance telephone lines and for rapid transmission telegraph lines.

Aluminum, next to gold, is the most malleable of all the metals, and is much more malleable than copper.

Aluminum, in ductility, stands next to copper, and is easily drawn into all sections that are furnished in copper for electrical conductors.

Aluminum can be furnished fully as uniform in its composition as copper.

The metallurgy of copper is comparatively complicated, owing to the difficulty of converting its ores into the oxide free from impurities. In most of the copper ores used sulphur, lead, and iron are contained, as well as small quantities of other elements, as arsenic and antimony. All of these elements in metallic copper very materially lower its electrical conductivity. The native pure copper of the Lake Superior region enjoys the preference, due to its uniformity and freedom from impurities, for many purposes, but for electrical conductors the electrolytic copper is most used.

Aluminum can now be furnished for electrical conductors at least 95·50 per cent. pure. It is granted not as yet rivaling in purity of composition the best electrolytic copper used for the purpose of electrical conductors. When as pure a metal is obtainable, undoubtedly it will nearly rival copper in electrical conductivity, section for section.

Aluminum has been already in successful operation as an electrical conductor for some time. The first use in a large way was with the conductors for the electric current at the Niagara Falls Works of the Pittsburg Reduction Company, where it has been used since the year 1895. The currents were of several thousand horse power each and of very large volume and comparatively low voltage. Both in conducting power, freedom from heating effects, power of withstanding corrosion, ease of making, wear and efficiency of joints, the aluminum conductors have given better results than copper used for the same purpose.

In the Chicago Stock Yards a mile of aluminum wire of No. 11 gage has now been in use for some time, upon a telephone line that had been badly corroded out in copper wire, due to its being frequently subjected to sulphur gases from passing locomotives. The aluminum line is giving good satisfaction and is withstanding corrosion much better than did the original copper wire subjected to the same influence.

If the theory be true that the passage of high voltage alternating currents of great frequency is largely upon or near the surface of the conductors only or mainly, then the larger section of the proposed aluminum conductors will make them especially adaptable for such currents.

On telephone lines it has already been determined that as good sound transmission is obtained with aluminum of equal section as with copper, in ordinary lengths of less than ten miles of wire. No comparative results, however, have as yet been determined on long distance telephone transmission; but the evidence would seem to point that a much less section than 160 of aluminum to 100 of copper will give equally good results.

Aluminum is now being used to replace brass very considerably in the arts, as it is sold in the open market at rates which make it ten per cent. cheaper, section for section, than brass.

For electrical purposes, the metal can be advantageously used to replace brass in a good many ways. Commercially pure aluminum as furnished to-day contains less iron than does commercial brass, and is, therefore, more non-magnetic than brass.

The electrical conductivity of aluminum is far superior, section for section, to brass. Almost every electrical apparatus of present construction in which an iron core—usually a laminated iron core—is used in motors, generators, or transforming machinery, has spaces for ventilation, and the spacing is made by the means of drawn bars, flat rods, or angles or tee shape pieces. Brass has been almost invariably used for this purpose in the past—probably on account of its non-magnetic properties as compared with iron or steel. Drawn aluminum sections can be furnished at a price which is ten per cent. cheaper than brass, section for section, and, on account of the lightness of aluminum, it can be advantageously used.

Where a low electrical conductivity is desirable, as in parts that are moved in a magnetic field, to prevent the occurrence of eddy currents, aluminum can be alloyed with zinc and other metals that will lower its electrical conductivity to the desired point.

COST OF MACADAM ROADS IN MASSACHUSETTS.

IN compliance with an order of the common council, Winslow L. Webber, city engineer, and F. R. Wheeler, superintendent of highways of Gloucester, Mass., have made estimates of the cost of macadamizing Eastern Avenue, Prospect and Washington Streets, Essex Avenue, East Main Street, and Maplewood Avenue. They state that the cost of State highway construction under the contract system during the last three years has ranged from $6,600 to $24,547 per mile, and has averaged $10,033, divided as follows:

For grading and excavating	$1,241
For gravel	520
For Telford and drains	367
For macadam and shaping	5,694
For masonry	448
For guard rail	188
For paved gutters	191
For engineering, superintendence, and inspection	679
For minor construction, drainage, catch basins, culverts, etc	431
For stone bounds	54
For advertising	18
For weighing stone	24
For sundries	178
Total	$10,033

They state that the elements of the cost of a macadam road are so numerous and variable that it is always a local question which depends upon the cost of labor, superintendence, transportation, tools, machinery, character of stone, drainage of roadbed, etc. The estimates which they submit are based on the contract system. If the work is done by day labor under the direction of the highway department, 25 per cent. should be added. These estimates are as follows: Eastern Avenue, $10,000; Prospect Street, $5,500; Washington Street, $63,250; Essex Avenue, $47,250; East Main Street, $6,500; Maplewood Avenue, $4,900; Western Avenue, $1,400; Main Street, $3,400; total, $142,200. This estimate is for a total of about fourteen miles of macadam.—Municipal Engineering.

Though not a new thought, the superintendent of the gas works at Cracow, Austria, has proposed a new method designed to prevent the freezing of gas pipes. According to this plan, there is employed a brass cylinder, soldered upon the gas main and containing a basket of chloride of lime. The gas on passing through the basket causes the chloride to deliquesce and fall to the bottom of the box and there to liquefy, the liquid being drawn off from time to time and the chloride revivified by heating in a furnace to drive off the water. When the chloride begins to deliquesce its ability to absorb water is not great as when dry, but remains considerable still. Whatever the drawbacks to success involved in this method, it is admitted that, by means of some of the processes of manufacture now in vogue, chloride of lime is no longer very expensive and might come within the scope of this application; at any rate, it is acknowledged that the removal of water from gas would have the effect of increasing its lighting and heating power and largely preventing rusting and bursting of the pipes during freezing weather.

One Millionth Part of a Second.—A chronograph has been invented which is said to excel by far all former achievements in this field and to admit of measuring one millionth part of a second and even smaller spaces of time. The apparatus is based on the following principle: At the end of a tuning fork of a very high number of vibrations, a hole is provided, through which a pencil of rays falls upon the case of a revolving cylinder, whose circumferential velocity is 30 meters per second. In consequence of the quick vibration of the tuning fork and the rotation of the cylinder, the said luminous tuft describes upon the cylinder (which is doubtless covered with paper sensitive to light) a curve whose dimensions correspond to certain particles of time.—Deutsche Uhrmacher Zeitung.

ENGINEERING NOTES.

A very elaborate series of experiments on the tractive resistance of express passenger trains running on the Northern of France Railway shows (says Engineering) that the engine and tender resistances amount to about half the total. The trains on which the experiments were made weighed, on the average, 160 tons, exclusive of the engine and tender, which weighed 85 tons more.

Some important experiments were recently made in the Workman Engineering Building, at McGill University, by Profs. Adams and Nicholson, of the Faculty of Applied Science. They consist of taking filings or turnings of brass, copper, tin, and other metals, and by means of pressure, securing therefrom solid bars of metal, differing very little in appearance and strength from castings. The machine used in these experiments brings to bear upon the filing and shavings about 78,000 pounds pressure to the square inch, and this has the effect of welding them into a solid bar of metal.

The bridge builder's enemy, ice, may sometimes be converted into a friend. A case in point recently occurred in Canada with a bridge in course of construction across the Ottawa River at Nepean Point. There is a bonus in view for early completion; so the work is being pushed on as rapidly as possible. The river being frozen over, sundry operations have been carried on with the ice as a working platform. Soundings have been taken, constructive materials have been hauled and stored upon it, holes have been cut in it through which dredging operations for the piers have been carried out in 30 feet of water, and concrete deposited. In short, the ice appears to have caused no obstruction to the general work of subaqueous construction.

The Chilean cruiser "O'Higgins," which our government, and Spain as well, attempted to purchase, has had her trial trips, says Engineering News. She was launched in 1897, and has the following dimensions: Length, 412 feet; beam, 62 feet 9 inches; mean draught, 22 feet; displacement on this draught, 8,500 tons; coal capacity, 700 tons; engines, 16,000 I. H. P.; speed for 24 hours, over 19 knots. The mean of six runs, with full power, over the measured mile, with and against the tide, was 21·7 knots. Her armament includes three 8-inch, ten 6-inch, and two 4·7-inch guns, all protected by 6-inch and 5-inch armor, and the secondary battery contains ten 12-pounders and ten 6-pounders, protected by shields. She has five torpedo tubes, two of them submerged. The "O'Higgins" has a 7 to 5-inch waterline Harveyized steel armor belt 7 feet deep, covering two-thirds of her length, and a complete protective deck from 1½ to 2 inches thick.

In the course of constructing the great Transsiberian railway, many mineral fields of importance appear to have been brought to light, including over fifty coal deposits and fifteen iron fields. In 1895 there are said to have been carried on some four iron and steel works and fourteen other so-called metal works. A recent report states that "the variety of industry for which there is room, and the magnitude to which they can be carried after the railway and its branches to the north and south are completed, can hardly be estimated. The few iron and steel works which, on account of the richness and abundance of the raw material, have been created have had almost incredible expenses to contend with as regards transportation. This will be gathered from the fact that the freight on one Russian pood (thirty-six pounds) of tea, coming from China by caravan to the European border, amounted to twenty rubles, being about a year on the road."

The supply of water for Amsterdam and The Hague, in the Netherlands, is collected from sand dunes bordering on the sea. Works for furnishing Haarlem with water from a like source are being constructed. In the dunes near the last-named place, where they have a width of nearly 2½ miles, the summits are 20 to 23 feet above sea level. The quantity of rain water percolating through these dunes, and contributing to the ground water streams, is estimated at 1·19 inches per annum. For Amsterdam the water is collected in open canals, which are never excavated below sea level. For The Hague it is collected in stoneware pipes, in a bed of shells, laid at a depth of 13 feet below sea level. In Haarlem the water will be collected in wells of 50 to 66 feet below sea level. As fresh water is found at such depth under the dunes, while the water at the same depth in the immediate neighborhood is salt, it is thought that the hydraulic pressure of the dune water prevents sea impregnation. The water contains much iron in solution, and for this reason, as well as for other reasons, is filtered at the three places mentioned before being pumped into the mains. When the water is collected in wells or in pipes, it must be aërated before being filtered.

Complete reorganization of field artillery is now going on in France and Germany. It is believed by the heads of the armies in the respective countries that before the year is out each nation will have the most formidable artillery corps in the world. Even before the reorganization was begun both these neighboring countries had their batteries completely provided with breech-loading cannon and machine guns. Now, however, the tactics have been thoroughly revised and nothing but rapid-fire guns will be employed. Already the German Imperial Guard and the three army corps of the west have been reorganized to the use of the new Krupp rapid-fire gun, whose mechanism is kept a profound secret, and which is said to be the most terrible war engine of its kind in the world. In France the two army corps of the east have already maneuvered with their new artillery, which by native and Russian critics is pronounced to be the most formidable in the world. Concerning the rapid-fire artillery, a Parisian paper has this to say: "Russia, Austria, Italy, and England are still at their preliminary studies with the rapid-fire field gun. It is a curious fact that the two allies of Germany, like Russia, are contented to have their material strength weakened by still employing the old-fashioned breech-loaders. The rapid-fire field gun is destined to play a tremendous part in the warfare of the future. A single park of the new French gun can easily annihilate an army of tens of thousands."

ELECTRICAL NOTES.

The "Yale," the "Harvard," and the "Minneapolis," refitted at Newport News, will be furnished with extra searchlights of the highest power. It is said that these three ships will have more searchlights than any other vessels in the navy when they are thoroughly overhauled.

"Calcidum" is the name given by Herr Büsse to a new exciting liquid for electric batteries. The new agent consists of oxychloride of calcium dissolved in a solution of sal ammoniac. This exciting liquid is very cheap, a good conductor of electricity, and does not crystallize even at zero temperature.—L'Electricien.

An electrically worked underground tubular post for letters and parcels has been designed by Dr. Alfred Brunn and Mr. Viktor Takács, of Budapest, and submitted by them to the Hungarian postal authorities. It has been decided to lay down a trial line from the eastern to the western stations of Budapest, and, if a year's working proves successful, the postal authorities will take over the line, and a scheme for connecting twenty-three offices on both sides of the Danube will be carried out.

Some experiments were made recently with the telephone between Manchester and Brussels, the operators at the two cities being put in direct communication with each other. Additional interest attached to the experiments from the fact that land and sea wires had to be utilized, the wires running from Brussels through Coutrai and Lille to Calais, where they were connected with the London-Paris telephone cable under the Straits of Dover. The experiments were very successful, the conversations being distinctly heard.

Mr. James Wimshurst, the inventor of the influence machine, has been elected a fellow of the Royal Society. He was born in 1832. He first published particulars of his machine in 1882. His qualifications were: (1) Improvements in electrical influence machines; (2) an influence machine which gives charges of electricity, alternating from positive to negative with each rotation of the disk; (3) has delivered a lecture upon influence machines at the Royal Institution April 27, 1888, and read papers at the Physical Society April 17, 1891, and June 22, 1893.

The long-talked-of telephonic communication between the two Russian capitals, Moscow and St. Petersburg, is likely this year to become an accomplished fact, says The Electrical World. The line is under the control of the Imperial Telegraph Department, and the stations will be at the chief telegraph office in either city. As the average speed of ordinary telegraphic dispatches between Moscow and St. Petersburg, which are four hundred miles apart, is about that of the railway, ten or twelve hours being considered good time, the new telephone will prove an inestimable boon to business men, who in case of urgency are now obliged to pay three times the ordinary tariff to get their dispatches through as "special" messages. The line is not likely to be actually in working order before October.

Balmoral Castle is to be lighted by electricity, generated by water power at the upper part of the Gelderburn, about one and one-half miles from the castle, says London Engineering. Provision is being made for two Gilkes vortex turbines, which, with a fall of nearly 80 feet, will give 80 horse power combined. This power will be utilized in driving the dynamos for charging a large battery of accumulators at the castle, and also for lighting the lamps direct. The current will be transmitted by large cables laid underground all the way. The electric light will at first be limited to the Queen's private apartments, the ball room, and a few of the principal rooms in the castle, and the installation is expected to be in working order by the time Her Majesty returns to the north next month. Eventually more than 600 lights will be installed in the castle alone, but if electric lighting is extended to the stables and outbuildings, about 1,000 lights will be required.

A writer in the Staats Zeitung corrects a very common supposition in regard to the heating capacity of wood, the most notable fact in the case being that such a practical and easy demonstrable error should so long have prevailed, namely, that the heating capacity of hard wood is greater than that of soft wood. The fact, as ascertained by repeated determinations, is that the greatest heating power is possessed by one of the softest varieties of such material, viz., the linden. Taking its heating capacity by the unit, the second best heater is also a soft wood—fir, with 0·99 heating power; next follow the elm and pine, with 0·98; willow, chestnut, larch, with 0·97; maple and spruce fir, with 0·96; black poplar, with 0·95; alder and white birch, with 0·94 only; then comes the hard oak, with 0·92; the locust and the white beech, with 0·91; and the red beech, with 0·90. These examples leave no doubt of the general fact that hard wood heats the least.

In an interesting paper by Mr. J. C. Thompson, which appeared in The Electrical Engineer, of New York, the author considers the question of color in electric lighting. He says: "The effect of the reflective powers of various colors and characters of surfaces is not sufficiently appreciated. Where the lighting is of necessity economical, it makes a great difference whetner the ceiling, walls, and furniture reflect 50 per cent. or whether they reflect 10 per cent. of the light they receive. Offices, workshops, schoolrooms, lecture halls, etc., therefore, should be finished in the lighter and warmer colors in order that a minimum of light may be necessary for their proper illumination. The following list of colors, with the respective reflective properties in percentage of incident to reflected light, will make this point clear: Black velvet, 0·4 per cent.; black cloth, 1·2; deep chocolate, 4·0; black paper, 4·5; dark blue, 6·5; dark green, 10·1; dark brown, 13·0; bright red, 16·2; dirty yellow, 20·0; dark brown, 23·2; white sandstone, 24·0; blue paper, 25·0; yellow cardboard, 30·0; straw yellow, 34·4; yellow paper or paint, 40·0; green paper, 46·5; yellow paper, 50·0; gray paper, 50·0; light colored wood, 50·0; bright yellow paper, 50·3; light orange paper, 54·8; white paper, 70·0; freshly fallen snow, 78·0; whitewashed ceiling, 80·0; dead white, 80·0; white blotting paper, 82·0; mirror, 83·0; white cardboard, 92·3."

SELECTED FORMULÆ.

To Remove Tar from Glass, Polished Surfaces, etc.—Make a paste of the consistency of cream, of pulverized anise seed and extract of licorice, and rub it thoroughly, with the hand, with the tar. Wash off with soap and water, and dry with a soft rag.

To Remove Mildew from Cotton Goods.—Steep the spots in a solution of sodium bicarbonate for a few minutes, then remove to a solution of calcium chloride. Remove, rinse in clear water, and dry. Or, rub well with common yellow soap, dampen slightly, then add a mixture of cooking salt and starch, in equal proportions, and place in the bright full sunshine.

The Best Way to Clean Ivory.—Dampen a stiff brush, an old tooth brush or nail brush, dip it into bicarbonate of sodium, and with this (with the addition of enough water to make a paste) scrub the ivory. If the ivory has become dulled, the polish gone, scrub in the same manner with rouge powder, afterward using the bicarbonate, and rubbing with soft flannel.

Waterproofing Varnish for Storm Coats, Umbrellas, etc.—Ordinary osnaburgs, or other cloth, can be made waterproof by giving it one or two coats of the following:

Oil of turpentine	2 parts.
Powdered litharge	1 "
Linseed oil	3 "

Mix and boil together in a water bath.

Universal Puts Pomade.—According to the Neueste Erfindungen und Erfahrungen, this is prepared as follows:

Red oxide of iron	15 parts.
Pumice stone	20 "

Mix and grind together until reduced to the finest powder. Sift through gauze, and rub up with 60 parts of palm oil, 4 parts of petroleum, and 4 parts of oil of mirbane.

To Plate any Metal with Brass.—According to the Bayerische Industrie und Gewerbeblatt, an even deposit of brass can be put on any metal by using the following bath and a current of from 3 to 4 volts: Zinc and potassium cyanide, 20 gm.; copper potassium cyanide, 20 gm.; sodium carbonate, 4 gm.; potassium cyanide, c. p., 75 egm.; ammonium chloride, c. p., 75 egm.; distilled water, 500 c. cm. Dissolve and warm from 20° to 25° C. (68° to 77° F.) Arrange as for any other electroplating.—National Druggist.

New Method of Flashing Hollow Glassware.—In this process the first step is to prepare a quantity of very thin flakes of colored glass by flashing a bulb of white glass with colored and covering this again with a thin layer of white glass, then blowing water into the hot bulb, and when the steam thus generated has formed it into a large thin ball, breaking the latter up into fragments, which will thus consist of a colored sheet inclosed between two white ones, which protect the pigment from the action of the fire gases. The glass to be flashed is then dipped while in a softened condition into the box containing the flakes and becomes covered with the latter, after which it is heated again until they melt, and is dipped (once or oftener) again into the flakes, to insure uniformity of coating, and afterward finished in the usual manner. An even simpler method of flashing is to prepare a very fusible and intensely colored glass, reduce it to fine powder by quenching in water and grinding, and then place it in a box, the bottom of which can be shaken rapidly so as to cause a cloud of the dust to arise and cover the surface of the ware to be flashed, this being introduced into the box hot and turned around so as to become evenly coated. The adherent powder melts and runs over the hot surface, and the ware is then placed in the annealing oven. In the case of colors able to stand fire—such as blue, green, or violet—the glass mass may be blown after the dusting process, but gold or silver colored flashing glasses must be applied as directed, since they will not resist the influence of direct fire.—Sprechsaal.

Fire Extinguishing Agents.—One of the best agents for extinguishing fires, according to The National Druggist, February, is aqua ammonia, without any addition whatever. "We have personally had experience with the almost marvelous power of this substance in this direction," says the editor of that journal. "In one instance, where fire had originated, probably from spontaneous combustion, in a pile containing several tons of cotton seed, and the interior of which was almost a solid body of live coal, a half gallon of ammonia completely smothered the fire. In another, which occurred at Savenay, France, the vapors of a tank containing fifty gallons of gasoline caught fire in the linen room of a laundry. The room was instantly a mass of living flames, but a gallon and a half of ammonia water thrown into it completely and almost immediately extinguished the fire. The ammonia was in a glass demijohn in an apothecary shop next door to the laundry, and was thrown into the room by the druggist as an experiment. To use his own words in reporting the circumstance (in the Union Pharmaceutique), M. Janneau, the pharmacist, says: 'The effect was instantaneous—torrents of black smoke rolled upward in place of flames, and in a moment every trace of fire was gone. So completely was the fire extinguished that workmen were enabled to enter the room almost immediately, where they found the iron tank of gasoline intact.'"

To Damascene Gun Barrels.—In an answer to a correspondent, the Pharmaceutische Centralhalle gives the following directions: Take of solution of chloride of iron (1·281 specific gravity), 14 parts; mercury chloride, 3 parts; fuming nitric acid, 3 parts; 3 parts of copper sulphate and 80 parts of water. With this give the barrel from two to three coats, scratching off the former coating each time, with a steel brush, before putting on a new one. Place the barrel in a solution of potassium sulphide (liver of sulphur) in 900 parts of water, and let remain for ten days, then remove, wash with soap and warm water, rinse, dry, and varnish with linseed oil varnish. If the damascene lines of the structure of the metal are to be brought out clearly and sharply, the browning should be removed from the course of the welding of the ribbon of metal, of which the barrel is composed. This is done by going over it with the edge of a rounded hone or oil stone.

THE TASKER & SNOW SEGMENTED SHAPING AND POLISHING WHEELS.

In shops equipped with up-to-date machine tools, the grinding wheel is gradually assuming more and more importance, but, as far as we know, there is no form of it that has been the object of so extensive applications as the one devised by Messrs. Tasker & Snow. That the ordinary solid grinding wheel is apt to burst, and that the pores of the material operated upon are apt to get choked up, are facts that are well known, and it is just these two inconveniences that the new wheel is designed to remedy. The wheel is formed of segments 16 inches in length set into cavities around a disk and held in place by a rim. After the segments have been mounted between these two parts, they are tightened through the insertion of wooden wedges driven in with force. In measure as the segments wear away, they are driven outwardly, so that they may be utilized almost completely.

These wheels are applicable to the most varied work, and are combined with powerful machines that possess the mechanical movements necessary for operating with rapidity and economy. Thus, for example, they are used for shaping the parts of machine tools, steam engines, locomotives, etc. The segments are of millstone grit or emery, according to the kind of work to be performed.

The figures given herewith, borrowed from the Revue Industrielle, give a few examples of the application of these new wheels. Fig. 1 represents a finishing machine designed with a view to the use of them. The wheel is mounted at the extremity of the shaft of a frame, provided between two large bearings, with a fast and a loose pulley of which the belt is shifted through a fork. This frame is capable of moving around a vertical pivot fixed in the carriage, upon which it simply rests and which slides upon a bed with beveled edges. At the end of the base of the frame there is a toothed sector which engages with an endless screw fixed to the carriage and capable of being actuated by a chain and wheel transmission upon which the workman, standing near the frame, acts by means of a hand wheel. Alongside of and beneath the latter there is a wheel provided with a handle and keyed upon a shaft that enters the transverse bed of the apparatus and acts, through intermediate toothed wheels, upon a screw which controls the motion of the carriage. The latter is thus moved very slowly when it is a question of regulating the contact of the wheel with the piece to be worked. But, ordinarily, the carriage may be moved rapidly backward and forward by a hand wheel keyed directly to the end of the screw.

The transverse support is firmly bolted at the base to a longitudinal frame upon which a carriage may slide. The latter carries the piece to be shaped, either directly, when it is of large size, or through the intermedium of a vertical frame of which the journals rest in supports fixed to the carriage. An endless screw and toothed sector mechanism allows the workman to incline this frame in such a way as to do oblique grinding, chamfering, and end finishing.

The carriage is movable upon its bed through a screw actuated by an independent belt and a train of gear wheels combined with a reversing mechanism, the lever of which, situated within reach of the workman, is visible in the engraving. The motion of the carriage may thus be reversed or arrested at will.

During the operation the workman maneuvers the chain wheel almost continuously, so as to cause the grinding wheel frame to pivot slightly from one side to the other. This mode of operating, which is common to all the Tasker & Snow machines, permits the wheel, while revolving, to bite more or less deeply into the piece to be worked, according to the hardness of the metal or to the degree of polish desired. The slight pivoting given the wheel during the operation effects, in addition, a constant renewal of the surfaces in contact with the metal, and this prevents the fouling of the wheel. The empty spaces between the segments contribute also toward this result, which is shown by a notable increase in efficiency. It suffices, moreover, on finishing a pass in one direction, to cause the piece to return in the other direction, and to give the wheel a very slight motion, in order to cause it to bite anew, without the necessity of shifting the wheel on its bed. Such pivoting may naturally be utilized for grinding concave and convex surfaces.

In the machine under consideration, the grinding wheel is 32 inches in diameter and makes from 380 to 400 revolutions a minute. The bed is capable of receiving pieces 6½ feet in length by 1 foot in width.

Pieces of all kinds can be finished thereon—lathe beds, frames, steam engine slides, connecting rod heads, elliptic springs, etc. It may also be used for finishing and chamfering in series all sorts of edge tools, and circular knives, even. It is a very strong machine, in which the working parts are of cast steel and which weighs about five tons.

In two Sheffield establishments there are several machines with segmented grinding wheels, of the type shown in Fig. 2, used for finishing the ends and sides of armor plate. This style of machine, like the one just described, is provided with arrangements that permit of causing the grinding wheel to pivot and slide upon a transverse bed. The armor plate to be worked is placed upon the bed plate of a planing machine and the axis of the grinding wheel is made to assume any angle required. The driving pulley is combined with a Lindsay spiral gearing that permits of a progressive starting and stopping without the slightest shock. By means of this machine, Harveyized plates of 16 inches thickness are worked with an

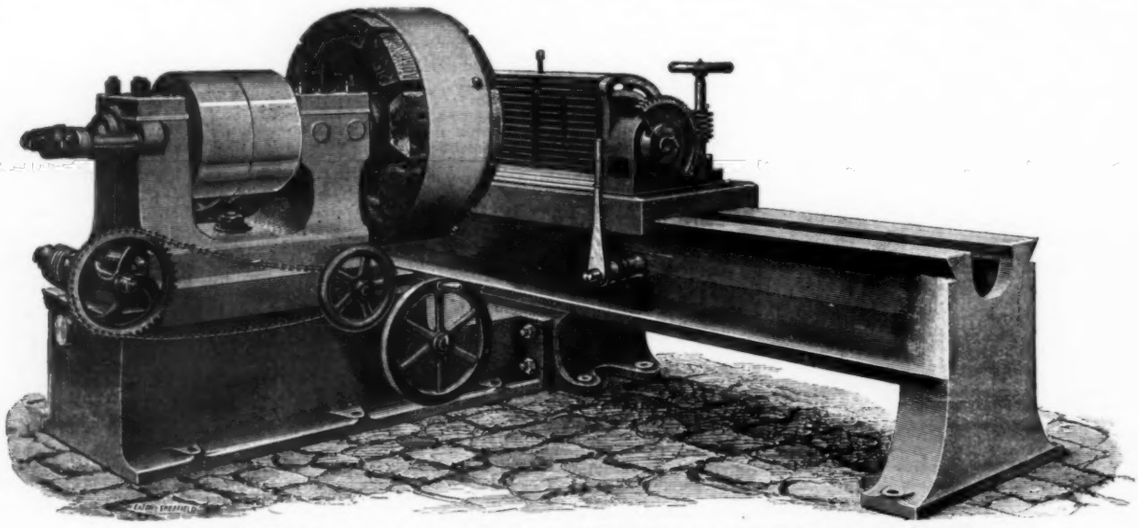


Fig. 1.—TASKER & SNOW FINISHING, CHAMFERING, AND POLISHING MACHINE.

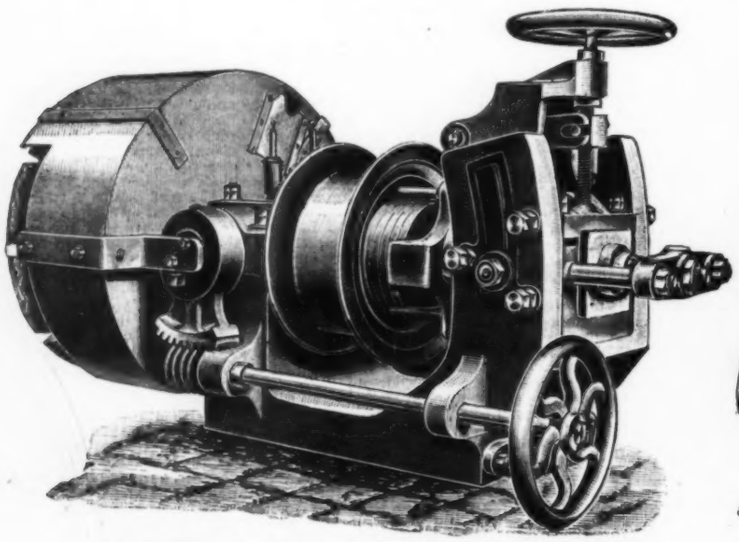


Fig. 2.—GRINDING WHEEL WITH INCLINING MECHANISM.

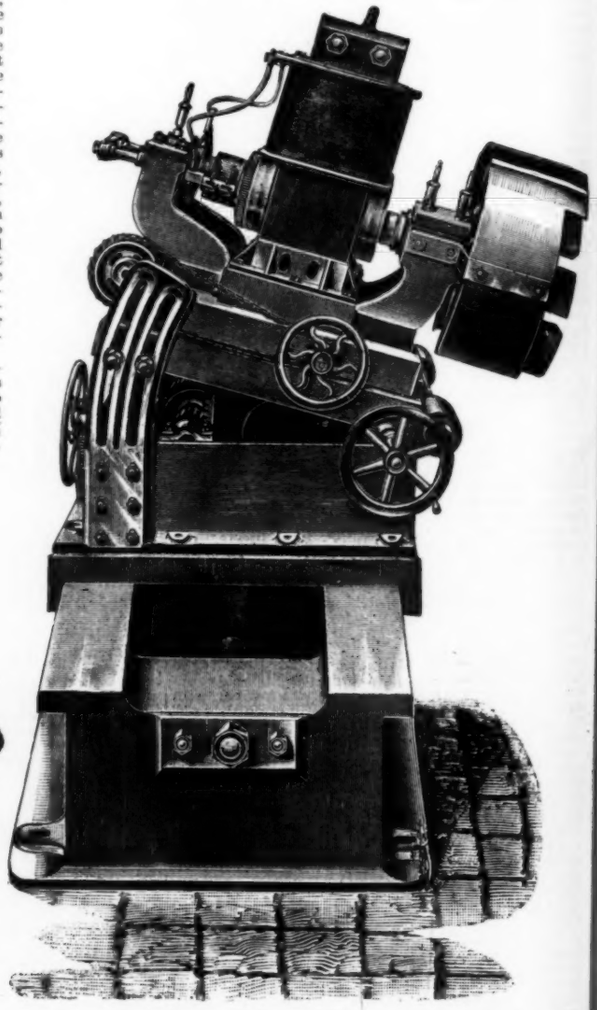


Fig. 3.—GRINDING WHEEL DRIVEN BY ELECTRICITY.

advance of 14 feet a minute with a wheel 32 inches in diameter.

For the turning of cylindrical pieces, hardened shells, and the cylinders of rolling mills, the same carriage is combined with a gap lathe, the mechanism of which is actuated by an independent transmission.

At the Krupp works and in one Sheffield establishment the manufacturers have installed a grinding wheel machine that is driven by electricity (Fig. 3). The wheel is keyed at the end of the shaft of a 20 horse power electromotor supported by a transverse carriage which, as in the preceding machines, is capable of pivoting around a central stud under the action of a chain and hand wheel.

The support is jointed in front upon the longitudinal carriage of the bed (which is very long), and the back of it may be elevated mechanically in such a way as to incline the grinding wheel at any angle required. The whole is then rendered immovable by the tightening of bolts which move in the slots of two curved supports fixed to the longitudinal carriage. The machine, which weighs six tons, operates in front of the armor plate. The planing machine bed required by the preceding machine for the reception of the plate is here dispensed with, and it is the mass of less weight that is set in motion.

This type, which is complete in itself, may be applied to the finishing of long and short pieces. It is especially well adapted for chamfering the edge of boiler plates with a great saving in manual labor and without any fear of damaging the piece operated upon.

It is well to add that these segmented wheels lend themselves indifferently to the working of soft, hard, or extra hard metals, from ordinary bronze or phosphor-bronze up to tempered steel.

HYDRAULIC FORGING PRESS AND ENGINES.

IN the accompanying illustrations may be seen the 600-ton hydraulic forging press and engines manufactured by Fielding & Platt (Limited).

The special feature of these presses is the very simple and effective system of valves, the invention of Mr. John Fielding, whereby power is economized to the fullest possible extent, while the working is much simplified. This system is applicable equally to presses worked by direct pumping accumulator or steam intensifier. The arrangement is such that pressure water cannot be admitted to the press cylinder except for the actual pressing operation, even by the carelessness or want of skill of the attendant. There is, therefore, no necessity for limiting the length of stroke, so that ample clearance may be given to allow of free manipulation of the forging. The effort required on the part of the attendant is very slight, as only one small valve has to be hand worked; all other valves belonging to the press and pumping engines or accumulator are automatic in their action.

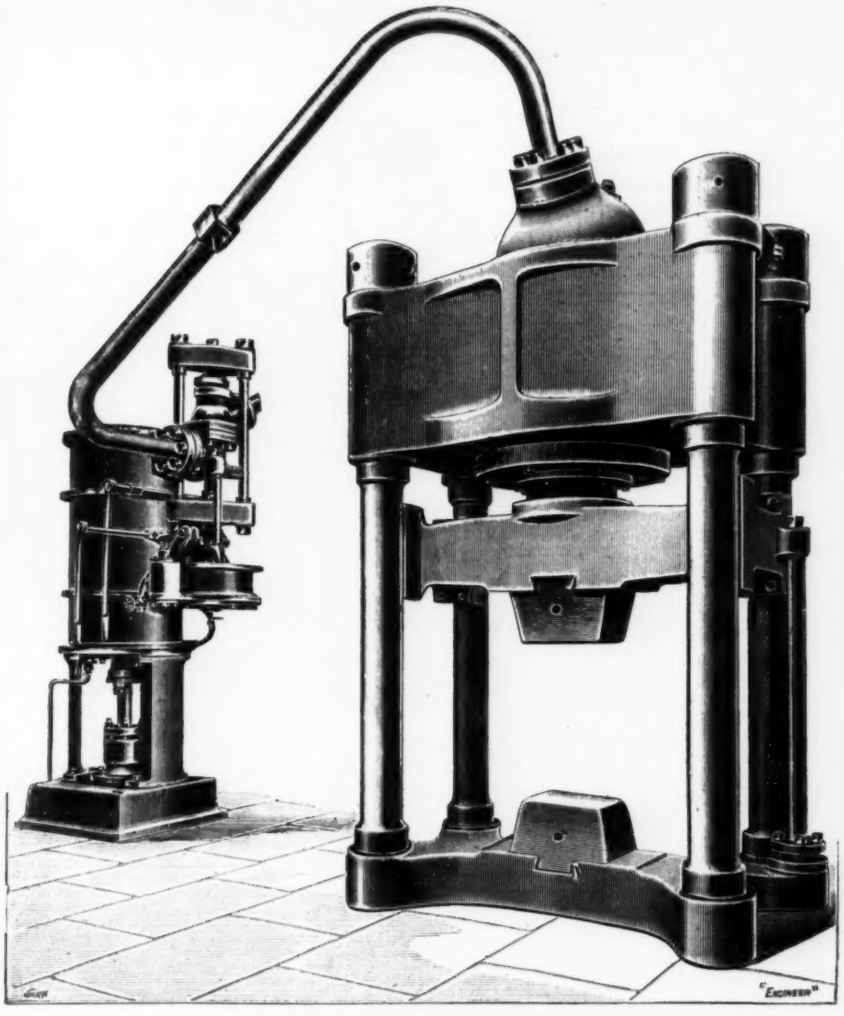
One of the engravings shows a view of a direct pump-driven press of 600 tons power, the engines for which are also shown. The lifting movement of the press is given by a pair of direct acting rams, one of which only appears in the cut, operated by a steam loaded hydraulic ram. Pressure can be taken off these rams to lower the press down to its work, or when short, quick strokes are required, pressure may be left constantly upon them. The pumping engines are of the three-crank type, driving three single acting pumps, the rams being directly connected to the crossheads. Double piston-rods connect the latter to the pistons. In more recent installations piston valves are used, placed at a lower level than the cylinders, which are thus kept perfectly drained.

The engines are very massively proportioned, and are automatically controlled by the action of the press valves. When the press is at rest the engines are kept slowly moving, so as to keep the cylinders warm and free from condensed water.

Presses worked by direct pumping are proportioned for a maximum pressure of three tons per square inch, steel cylinders lined with gun metal and packed by cup leathers being used. For working the lifting cylinders a pressure of 1,500 pounds is employed. All packings where possible are of hemp, which Messrs. Fielding & Platt find by experience to be preferable on account of the ease of removal. They regularly use this kind of packing up to pressures of two tons per square inch, with excellent results.

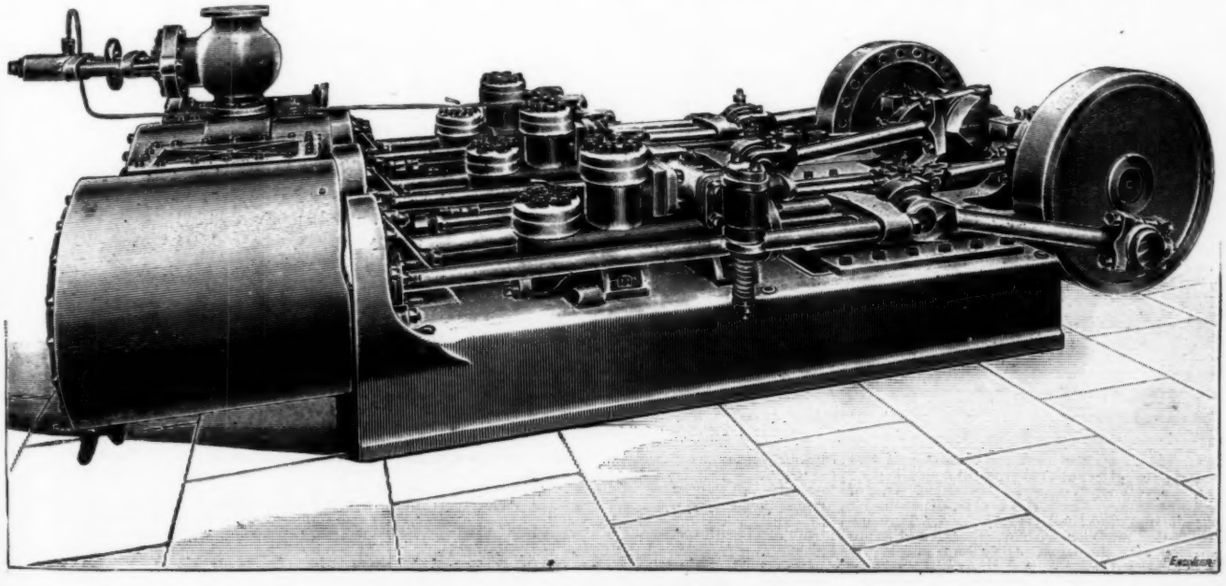
Steel is, of course, mainly used in the construction of these presses, cast iron being only used where its compressive strength makes its suitable, as in anvil blocks, distance pieces, etc.

We are indebted to The Engineer, of London, for the cuts and copy.



600-TON HYDRAULIC FORGING PRESS.

The principle of a new method employed in the measurement of high temperatures depends on the fact that if the density of a gas is diminished by a certain fraction either by diminution of pressure or by rise of temperature, the refractive index of the gas takes the same value in the two cases. A beam of light is divided, one half traversing a tube of air in which the pressure can be varied and measured, the other half traversing a tube of air which can be heated electrically by a coil of wire surrounding the tube; the two halves are then recombined, so as to give interference fringes. The pressure of gas in one tube is varied so as to counterbalance any motion of the interference bands due to rise of temperature in the other, and the rise of temperature is then calculated from the variation of pressure. To eliminate the variations of temperature along the tube a differential method is employed, by which only the influence of a certain length of the middle portion of the air column in which the temperature is constant is measured. An accuracy of one degree up to the temperature of fusion of gold is claimed.—Comptes Rendus.



ENGINES FOR HYDRAULIC FORGING PRESS.

ONE HUNDRED YEARS OF GINNING AND BALING COTTON.*

By George A. Lowry, Boston, Mass., Associate Member of the Society.

GINNING.

In the year 1784 an American vessel arrived in Liverpool with eight bags of cotton, which were seized by the customs officials on the ground that it could not possibly be American cotton. Next year there were five more bags exported, six bags in 1786, and one hundred and eight bags in 1787. This was all Sea Island cotton (i. e., long staple cotton), for until 1791, when Whitney invented his cotton gin, upland cotton (i. e., short staple cotton) was practically unknown. This short staple cotton adhered so obstinately to the seed that an operator could clean only one pound per day.

Two years after Whitney's invention of the gin, the crop had grown to 5,000,000 pounds; ten years later, to 35,000,000 pounds; and in twenty years it had grown to 85,000,000 pounds, while the estimate of the crop last year (that of 1897) was 5,500,000,000 pounds. Of this, only 50,000,000 pounds is Sea Island cotton, the remainder being upland.

In the year 1791, two operators could produce two pounds of cleaned cotton per day. With the present system of automatic feeders, etc., only two men are required to remove the cotton from the wagon and attend to six gins, producing 24,000 pounds of cleaned cotton daily.

Previous to the invention of the Whitney gin, a small roller gin (invented in India some centuries ago, and called a "churka") was used. It consisted of two rollers placed parallel to each other, with a small space between, and revolving in opposite directions. One of the rollers was smaller than the others, the smaller one being of iron and the larger of wood. The operator turned the machine with one hand and fed in the seed cotton with the other. Only long staple cotton (which is easily detached from the seed) could be cleaned with this machine, and its output was about three pounds per day. Most of the roller gins of today are modifications of this type, the widest departure being that of the McCarthy gin, which consists of a leather roller and two steel blades, one of the blades being pressed against the roller, while the other blade has a rapid reciprocal movement, and strikes the seeds as they are drawn against the edge of the first blade by the adhesive action of the cotton to the rough surface of the revolving leather roller. This rapid striking movement detaches the seeds from the fiber.

The original Whitney gin consisted of a drum with rows of wire hooks, or teeth, inserted in line around it. As the drum revolved, these teeth passed between a grate, or grid, the bars of which were sufficiently far apart to permit the teeth to pass without touching, but so close that the seed could not pass between. Another grate, wide enough to allow the cleaned seeds to drop through, was mounted to form a hopper for the seed cotton, and hold it against the revolving drum. The revolution of the drum, coupled with the drawing action of the teeth against the cotton in the hopper, caused the cotton also to revolve and form into a roll, thus resulting in continually presenting new material to the teeth, and giving the cleaned seed a chance to drop through the wider grate forming the hopper. As the teeth, or hooks, passed through the roll, they became charged with filaments of cotton, and the seed being held back, either by the surrounding material pressing against it, or by its contact with the forward grate, caused the filaments to be detached from the seed and carried forward by the drum, until they were removed by a brush revolving with greater rapidity in an opposite direction, and in such a manner that the bristles brushed the teeth in the direction in which they were inclined. This removed the filaments of cotton from the drum, and the speed of the brush was sufficient to clear itself by centrifugal action. As will be seen by the accompanying drawing (see Fig. 1), the Whitney brush was four-armed.

Numberless patents have been issued, and a few improvements made on the Whitney gin, but the principle remains the same. Instead of the wire teeth fixed in a drum, we have teeth cut out of a circular metal plate. The brush consists of a drum, with rows of bristles inserted lengthwise across it, and with wings on the end to give an air current. Rotatable plates have been placed at the ends of the cotton roll to reduce the friction and assist it in revolving, and, perhaps, the most important improvement is the mote board,* which regulates the current of air produced by the wings on the brush so nicely that the current is just strong enough to carry off the cleaned cotton, but not enough to carry off the motes, or immature seeds, which thus become separated as wheat is from chaff. The addition of this air current, and the passing of the cotton through flues to a lint room or condenser, also materially assists in opening up the neps occasionally caused by the films of cotton doubling around the teeth and becoming snarled.

The lint room was merely a large compartment, or box fitted with screen ventilators, into which the cotton was blown, the ventilators allowing the air and dust to pass away.

In 1878 a condenser was added and made a part of the gin. This condenser is a revolving screen, and as the cotton is blown against it, the air passes through, leaving the lint on the face of the screen in the form of a bat, the air passing out through the bottom and ends of the condenser, and carrying the dust and dirt with it, the screen, as it revolves, constantly presenting new surfaces to the oncoming cotton. A bat roll is placed over the top of the revolving screen and lifts the cotton from it, delivering it into a chute.

Fig. 2 shows the gin with the improved brush and lint room as made in 1848.

Fig. 7 shows the gin and condenser as manufactured at the present day.

Fig. 1.

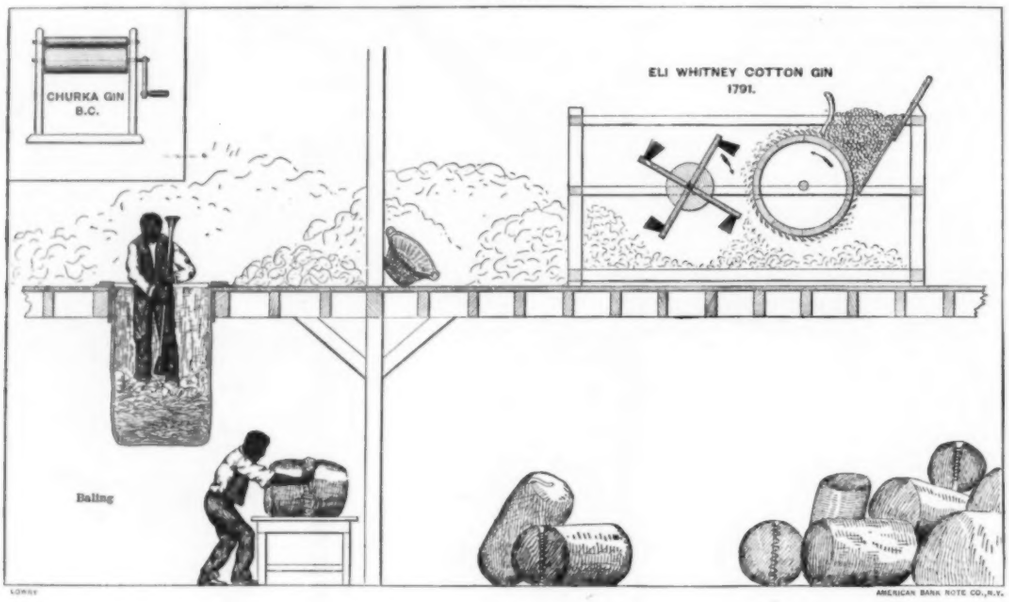
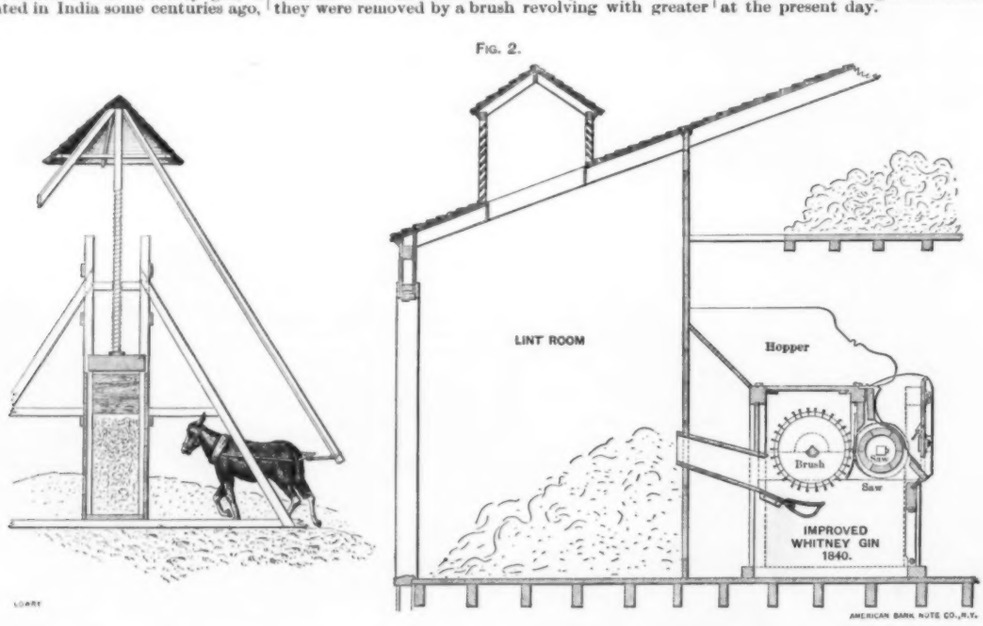


Fig. 2.



The capacity of a roller gin is about 400 pounds daily. The capacity of the improved Whitney gin is 4,000 pounds per day.

A roller gin consumes 71,000 foot pounds of power for each pound of cleaned cotton, against 35,000 foot pounds on a Whitney for the same quantity.

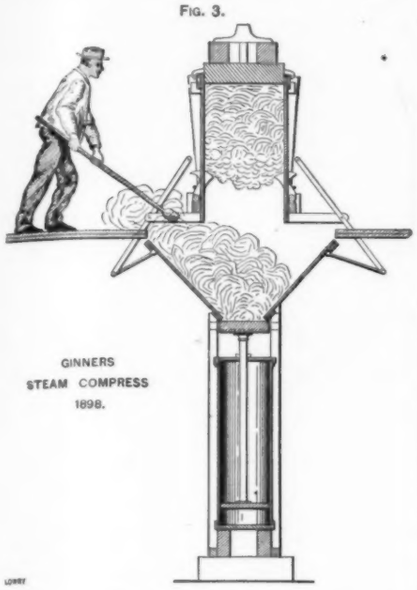
The Whitney gin has, unfortunately for itself, become known as the "saw gin," and I will hereafter speak of it by that term. I say "unfortunately," for

* Presented at the Niagara Falls meeting (June, 1898) of the American Society of Mechanical Engineers, and forming part of Volume XIX. of the Transactions.

* Invented by Eleazer Carver, in 1845.

the word "saw" has a ripping sound, and has resulted in the general and mistaken belief that this form of machine is particularly injurious to the fiber, while the actual facts are that the saw gin does not hurt the cotton any more than does the roller gin, and neither of these gins will hurt the fiber materially, unless run at too high speed, as the injury to the cotton depends upon the suddenness of its detachment from the seed. Every sample of cotton contains a portion of

FIG. 3.



weak fibers, running all the way from a tensile strength of from 46 to 212 grains (breaking strain), and, naturally, the weaker fibers suffer the most in ginning. Cotton from saw gins shows a little more neppiness than from roller gins, but the cotton from the latter will be more curled and twisted, and this curling in cotton is very apt to result in neppiness when being carded.

The cotton from saw gins is much cleaner than from roller gins, and opinions for or against these machines will depend upon whether most attention is shown to neppiness or cleanness. If the teeth in a saw gin are made smooth and well rounded at the root, and curved so they will enter the cotton at the right angle, they will not injure it unless run at a very high speed, but it unfortunately happens that most of the ginning in this country is done by custom ginners, who get so much per bale for their work, and whose interest lies more in the quantity they turn out than in the condition of the cotton after it is ginned, and, as a rule, they run their gins at a very injurious speed. They would do the same with the roller gins, however, and the results obtained would be equally as bad.

A number of tests made carefully on cotton obtained from saw and roller gins show the following results, viz.:

2·5 per cent. degree of neppiness from roller gins.
2·7 per cent. degree of neppiness from saw gins.

Cleanness:

0·8 per cent. of leaf from roller gins.
0·00 per cent. of leaf from saw gins.
1·2 per cent. of crushed seed from saw gins.
1·5 per cent. of crushed seed from roller gins.

Seven samples taken from a hank of yarn, made from roller ginned cotton, showed an average deterioration of 1·4 per cent., while eight samples of yarn made from saw ginned cotton showed an average deterioration of 1·7 per cent.

If "the man who causes two blades of grass to grow where one grew before is a benefactor to his race," how much more so is the man who causes 25,000,000 acres of land to be tilled where one was tilled before?

This Whitney has done for the South. How has the South shown its appreciation?

BALING.

The world's exports of cotton goods amounted to about $400,000,000 in the year 1896. Of this, 95 per cent. is manufactured in Europe and only 5 per cent. in the United States, and only one-tenth of the latter amount is manufactured in the South, where the cotton is grown.

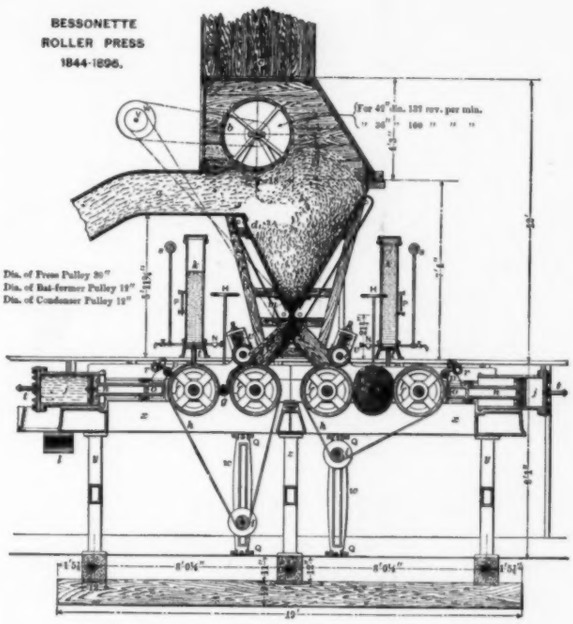
This has necessitated shipping the greater part of the crop many thousands of miles, and a tremendous outlay for freight and bagging. To mitigate this, many millions have been expended in order to reduce the cotton to a density which will give ships and cars their full capacity of tonnage, which is about 40 pounds to each cubic foot of space (if the package is round, it would require 47 pounds to the cubic foot).

There are about $70,000,000 now invested in the large compresses at central points, and about $20,000,000 in planters' presses.

The first system of baling cotton, used in the years 1780 to 1810, was that of tramping and mauling it into round bags about 9 feet long and holding about 300 pounds, as shown in Fig. 1. This compressed the cotton to about 5 pounds per cubic foot. Then was introduced the old fashioned wooden screw press, shown in Fig. 2, which compressed to a density of about 8 pounds. Between the years 1840 and 1860 were introduced the power screw presses, and about 1870 the steam press as shown in Fig. 3. The latter two forms of press are those most in use at the present time, and press cotton to about 12 pounds per cubic foot. The best results from these give but one-fourth of a load. In 1845 was introduced the Tyler hydraulic compress, and in 1874 the Morse steam compresses were introduced for the purpose of recompressing the bales put up by the planters and ginners. The immense outlay for such plants prevented their erection at other than central points and seaports; the cost for the compress alone being from $40,000 to $60,000, and requiring a steam capacity of three 150 horse-power boilers. (The latest form of these is shown in Fig. 4.) The pressure exerted by these gigantic machines is from 5,000,000 to 6,000,000 pounds on each bale, or about 2,800 pounds per square inch; the bale while under the press being reduced to about 60 pounds density to the cubic foot; but so far they have been unable to keep it from re-expanding when released from the press, and the average obtained is only 22½ pounds per cubic foot. Very few bales "dock" at Liverpool with a greater density than 20 pounds per cubic foot. In re-expanding, the bales assume a turtle back shape, which prevents their being stored economically and necessitates "jack screwing" them into place when stowed aboard ship. The regular charges at New Orleans for recompressing, screwing, etc., are $2.04 per bale, and the job when finished is a mighty poor one.

The American Cotton Company, by their revival of the cylindrical baling machine, have done a great deal to stir up the planters and ginners to the fact that their present methods must be improved or abandoned. This cylindrical bale (which consists in winding a bat of cotton around a core, and putting pressure on the layers, as they are wound, by means of receding drums in sliding boxes held elastically against them) was first made by the E. Carver Company at East Bridgewater,

FIG. 5.



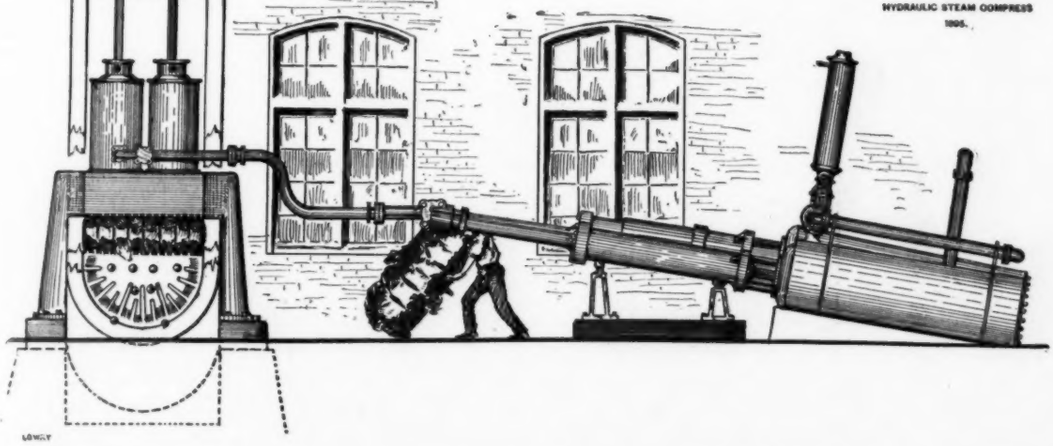
Section of Double Press, Bat-former and Condenser.

a—Lint flue. A-A—Baling belts. n-n—Piston rod.
b—Condenser drum. i-i—Belt idler. p-p-r-r—Tension rolls.
c—Dust flue. j-j—Hydraulic cylinders. s-s—Pressure gauges.
d-d—Bat-former aprons. k-k—Pressure column. u—Swinging chute.
e-e—Compression rolls. l—Press pulley. w-w—Guides for belt idler.
f-f-f-f-f—Baling rolls. m—Bat-former pulley. N.N—Pressure regulators.
g-g—Cores.

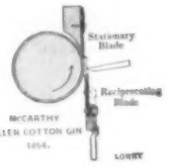
AMERICAN BANK NOTE CO., N.Y.

FIG. 4.

TAYLOR-BIERCE
HYDRAULIC STEAM COMPRESS
1895.



Massachusetts, in 1844, for J. E. Carver and W. F. Pratt. They spent $2,400 on the machine, but abandoned it because the mills objected to the difficulty of unwinding, and the felted condition of the cotton at the center of the bale, caused by the layers creeping on each other, accumulating and concentrating the pressure toward the center. Each layer was necessarily less dense than the layer beneath, which it assisted in compressing, and the bale could only have an average (instead of a uniform) density, which was in inverse ratio to its diameter. (This peculiarity was strikingly exemplified some time since at the Ordnance Department at Washington, when



they tried to wind a steel gun core with wire, the result being a sufficient accumulation of pressure toward the center to crush the core.) Patents were issued in 1847 to Mead, and in 1848 to North, for machines of this type, but until the improvements by Bessonette, in 1893, no material progress was made in bringing it into practical use. There are now thirty-five plants established, which last season put up 60,000 bales of cotton, compressed to a density of about 30 pounds per cubic foot, the pressure exerted being 1,000 pounds to the square inch. (It must be remembered that about 17 per cent. is lost in stowing cylindrical packages.)

Fig. 5 shows this form of press as now constructed.

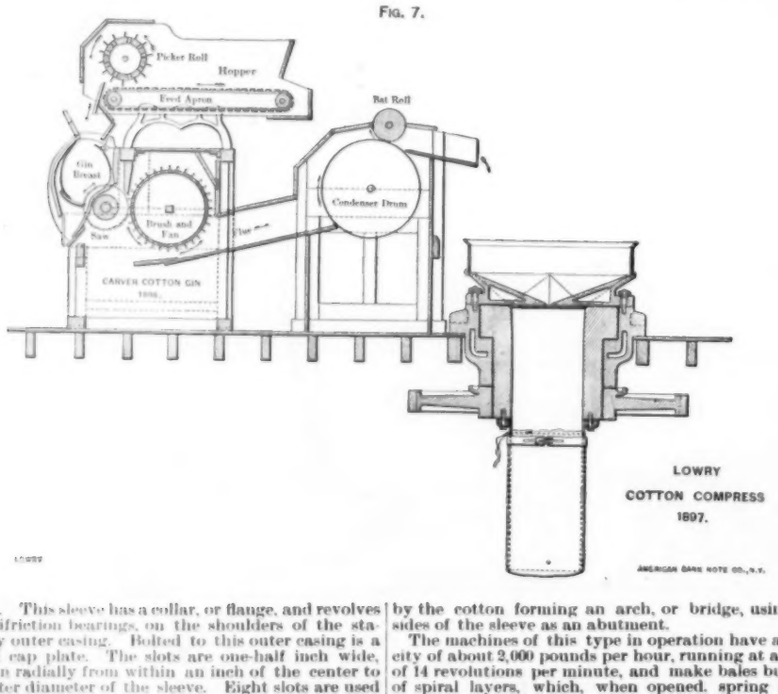
Between 1840 and 1850 two other forms of pressing cotton were invented, one of which had a circular tube with a revolving head containing a number of cone rollers placed parallel to each other with a narrow space between. As the head containing the rollers revolved, the cotton was intended to feed between them, but the inventor failed to notice that, as one side of the roller rotated inwardly, the other side of it must necessarily rotate outwardly, thus preventing any drawing in action on the cotton. As several other inventors have, within a few years, tried the same scheme with like results, the prior inventor (if still alive) need not feel humiliated at his want of foresight.

The other form referred to was twisting the cotton into a thick rope and coiling it on a spindle; this needs no comment.

During the past ten years efforts have been made by several inventors to pass cotton between metal rollers held tightly together, and have the rolls move reciprocally over the receiving box, or the receiving box move reciprocally under the rolls, thus folding the cotton into layers; the box in either case having a screw or hydraulic mechanism attached thereto to compress the layers of cotton. The greatest difficulty found with this style of machine has been to pass cotton between metal rollers without injury to the fiber.

The latest distinct form of press is that shown in Fig. 7. This press is somewhat of a mechanical problem, and the attention of the society, with a view to solving the principle involved, is particularly requested, as its application to a useful art is entirely new, and possibly capable of being much extended. The press consists of an inner sleeve, 19 inches inside diameter at the top, and drawn in to 18 inches in the first 12 inches of

FIG. 7.



length. This sleeve has a collar, or flange, and revolves on antifriction bearings, on the shoulders of the stationary outer casing. Bolted to this outer casing is a slotted cap plate. The slots are one-half inch wide, and run radially from within an inch of the center to the outer diameter of the sleeve. Eight slots are used on the present machine. On the inner sleeve is mounted a spur gear, by which the sleeve is made to revolve, and a drawn steel tube, to carry the bag for the reception of the cotton, is attached to the sleeve by a flange. In operation, the sleeve is first filled with cotton, sufficiently tight to give some pressure against the cap plate; the cotton, as it comes from the gins and condenser, falls on the cap plate, and some of the fibers become engaged with the cotton moving underneath the slots. These fibers draw in other fibers, with which they are interlaced, and in this way the whole body of cotton on the cap plate is soon engaged and kept moving toward the slots. As the cotton is drawn around the lips of the slots, the upward pressure of the material in the sleeve squeezes out the air and compresses the fibers, and there is no opportunity for re-expansion; this continuous introduction of new material forces the material already in the chamber downward. The narrowing of the diameter, or otherwise the choke in the sleeve, together with the length of the tube, gives the resistance which regulates the density of the bale.

To give a greater or lesser density the choke is increased or decreased and the tube lengthened or shortened. With this machine, and an exertion of 25 horse power, cotton has been compressed to a density of 86 pounds per cubic foot. (Oak is but 54 pounds to the cubic foot.) But in practice, the bales are only made to a density of 50 pounds per cubic foot, as that is sufficient for the full utilization of any shipping space. By taking in a very thin bat of cotton, only a small amount of pressure is needed to compress it to the required density; the large compresses find it necessary to obtain a pressure of 2,800 pounds to the square inch to compress a full sized bale to 22 pounds density, and the American Cotton Company, with a thicker bat, require 1,000 pounds pressure to obtain a density of 30 pounds, while with this thin bat only 60 pounds pressure to the square inch is required to compress the cotton to a density of 50 pounds to the cubic foot.

At the inception of this machine it was deemed impossible, by those consulted, to obtain enough frictional resistance, in a construction such as this on yielding material like cotton, to obtain any amount of density, and the first machine was made with 3 inches of choke in 24 inches of length, the chamber being 16 inches diameter at the bottom and 19 at the top. The first two bales came through, but the third had become so very solid that it could not be moved, and it finally pushed off the cap plate, stripping the thread from the bolts.

I am of the opinion that the resistance is created by the cotton forming an arch, or bridge, using the sides of the sleeve as an abutment.

The machines of this type in operation have a capacity of about 2,000 pounds per hour, running at a speed of 14 revolutions per minute, and make bales built up of spiral layers, which, when opened, spring apart, thus saving much arduous labor at the mills, and facilitating the mixing of the cotton.

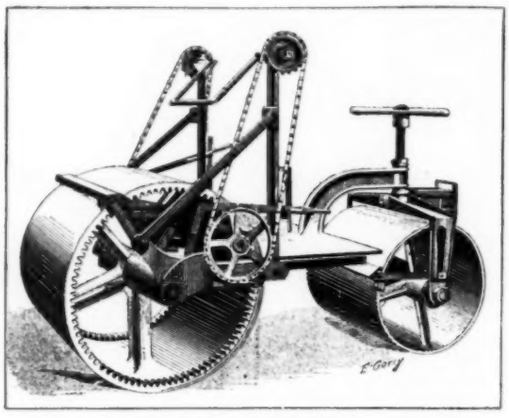
As will be seen from the construction of this machine, it is inexpensive to build, and will easily come within the reach of the planters and ginners, thus doing away with the recompressing and rehandling of cotton now made necessary by present methods, and will fully utilize the carrying capacity of ships and cars—making the saving on a crop as large as that of last season of over $40,000,000.

I beg to acknowledge my indebtedness to Dr. Forbes Watson, J. E. Carver, Silliman's Journal, and The Manufacturers' Record for much of the preceding information.

NOTE.—The revolving of the cap plate with a stationary sleeve gives like results.

A NEW ROAD ROLLER.

WHEN we speak of a road roller, we naturally think of a machine of colossal weight drawn with difficulty



A NEW ROAD ROLLER.

by four or six horses, or, what is better, actuated by a steam motor. It is certain that, for keeping wide roadways in repair, nothing is preferable to the steam roller. But it is not only upon public roads that a roller is necessary, for the use of such an apparatus is required in order to keep private asphalted courtyards and alleys smooth and level. Now, within a limited space, it is impossible to employ a machine actuated either by horses or steam, and recourse has to be had to man as a motor. The power of a man, however, is quite feeble, and the rollers that are given him to maneuver weigh but from 900 to 1,200 pounds, and these are entirely inadequate for the performance of good work.

A St. Louis manufacturer has devised an arrangement that permits of tripling the weight of rollers actuated by manual power without requiring an excessive effort on the part of the laborers. It takes but three men to maneuver this apparatus. One of these has the steering exclusively in charge (the apparatus, upon the whole, being a particularly massive bicycle), and has only to revolve a winch wheel in order to keep the roller in a straight path. The task of the two other men is more difficult. These, standing upon the same platform, revolve a double winch in bearings supported by two uprights. This winch revolves two cogwheels which, through the intermedium of a chain, actuate each of them another toothed wheel of greater diameter. These last mentioned wheels are mounted upon a shaft that carries a cogwheel of which the teeth mesh with those with which the interior of the compressing cylinder is provided. This latter is thus set in motion through a very moderate stress.

For the above particulars and the illustration we are indebted to La Vie Scientifique.

EXPERIMENTS ON THE WORKING OF GAS ENGINES.

A GENERAL meeting of the English Institution of Mechanical Engineers was held recently, when the president, Mr. Samuel W. Johnson, delivered an inaugural address dealing chiefly with the progress of locomotive engineering on the Midland Railway, of which he is chief mechanical engineer. The most interesting feature in the ordinary proceeding was the discussion of the first report to the gas engine research committee of the institution. The author of the report was Prof. Frederick W. Burstall, under whose superintendence the investigations had been carried out. The object of the experiments was to determine the effect produced upon the economy of gas engines by altering one or more of the conditions which governed their working. In internal combustion engines there are a much larger number of factors to consider than in steam engines, and it is difficult to ascertain where to look for economy. The factors to be considered are the amount of compression, the speed, the ratio of air to gas, and the amount of heat which is to be ejected through the walls of the cylinder. An increase of compression, for example, is often regarded as conducive to more economical results; but it is uncertain whether the attendant increase in economy is really due to compression alone. To ascertain this, the conditions of working should be altered successively one at a time. This has been done for the steam engine, but all published results of tests made on gas engines are based upon only one fixed set of conditions.

A small engine was used by the committee, but was one specially constructed for experimental purposes. Small size was an advantage, inasmuch as it allowed measurements, such as those of volumes of air, to be made with accuracy. The work of the committee appears to have been undertaken with commendable care, and a precision was aimed at more typical of the physical laboratory than of ordinary engineering experiments.

This is particularly noticeable in the arrangement of the apparatus and methods of calibration followed. It would take far too much space to follow these in detail, interesting and instructive as they are to engineers, and we can only hope to give a partial idea of the methods followed.

This report, it should be remembered, is but intro-

ductory to the description of the actual work of testing, most of which has yet to be undertaken. As the author stated, experimental work is often compromised by being carried out with instruments upon the accuracy of which no information is furnished. When a comparison is made of a number of results, it is always difficult to discover how far differences are due to working conditions or to inevitable experimental error. In purely physical experiments, the report continued, accuracy may be obtained to the degree of one part in a thousand; in a few special cases, even better results may be reached. In an engineering experiment it is hopeless to expect such accuracy, owing to the great difficulty of keeping the working conditions sufficiently steady from beginning to end of the experiment. With ordinary care, and the use of appliances which are found in all works, probably all that can be expected is to get results correct to 3 or 4 per cent. With special care, half of 1 per cent. may be reached; but the author does not suggest that all the results of the experiments made by the committee have this high degree of accuracy, but in the principal measurements probably the experimental error involved does not in any case exceed 1 per cent.

The engine used was of 2-horse nominal power, capable of developing a maximum of 5 indicated horse power; it has a 6-inch cylinder and 12-inch stroke. The valves are worked in the ordinary manner; there is an ordinary Watt governor acting on a small roller, and causing a charge of gas to be cut off when the speed is too high. To effect changes in compression the connecting rod is made so that its length can be varied. Compressions employed in the experiment varied between 35 and 90 lb. per square inch; variation in the amount of gas admitted was effected by throttling. For measuring the supply of gas a calibrated holder was used; the wet test meter being discarded, as it does not control the fluctuations of pressure in the mains.

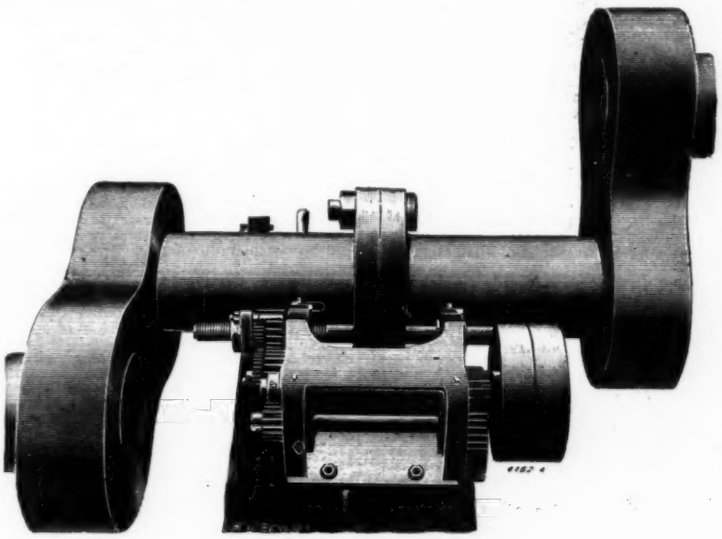
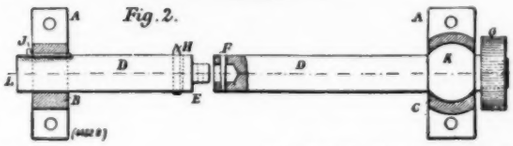


FIG. 1.



TAPERED HOLE WIDENING MACHINE.

By this instrument accuracy to the extent of one-tenth of 1 per cent. was obtained; calibration was effected by means of a standard cubic foot measure. To determine the air supply per stroke, a meter was used in place of trusting to the usual method of calculation. The arrangement followed was practically that employed by Dr. A. Slaby, of Berlin. The meter employed was a 400-light standard wet meter, made by Alexander Wright & Company, of Westminster. Air is passed in by a blower, the pressure being kept constant by a governor. After passing through the meter the air is delivered into a safety box, which is used to prevent inflammable gas from passing back into the meter, and also to give relief in case of back ignition. A rubber bag is used to prevent fluctuations in the meter during the suction stroke. The direct measurement of air supply is usually considered a difficult and dangerous undertaking; but the author stated that no trouble had been found with this portion of the apparatus. The air meter was checked by blowing air through it into the gasholder, and was found to be correct to the half of 1 per cent.

The amount of heat passed into the jacket was measured by running all the cooling water for a single test into a tank, and taking the temperature by means of thermometers. Samples of exhaust gases were taken and analyzed. In this detail the great difficulty is not in making the analysis, but in obtaining a true sample. A single bubble of gas was taken from just below the exhaust valve after each explosion. The apparatus for doing this was illustrated by means of wall diagrams, which showed that the object aimed at was obtained by an electrical relay which actuated a small needle valve that allowed a single bubble of gas to be sucked into the gas receiver. Power developed was ascertained by a Wayne indicator, an instrument found superior to others tried.

Prof. Burstall states that it is, in careful hands, apparently the most accurate indicator of the present time. It has a rotating piston in place of the ordinary reciprocating piston. This piston does not touch the containing cylinder at its outer extremities, but is guided at the center on circular bearings. In this way friction is small and not liable to change, because the bearings can be well lubricated. There are many interesting points about its mechanism which were described in the report. Thin sheets of smoked mica are used in place of the ordinary metallic-faced paper or "cards." This device is highly spoken of by those who have had experience in its use.

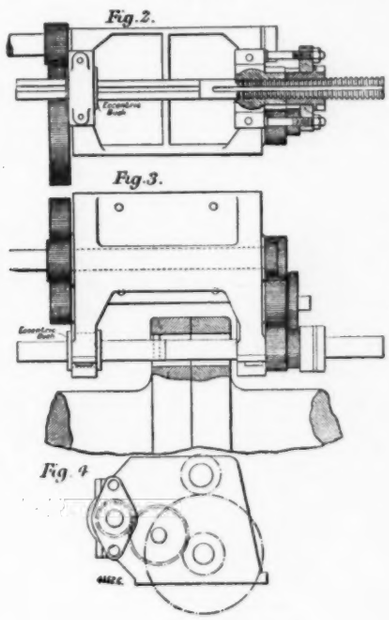
As the engine was not fitted with a timing valve—a device which the author considers absolutely necessary to all sizes of gas engines—it was decided to attempt to ignite the charge by means of an electric spark, and it was hoped that electric ignition would prove more certain than any form of hot tube igniter. This, however, did not prove to be the case; and not the least interesting part of the report is contained in the discussion of the failure in this detail. The rope-brake used was of the ordinary kind, having dead weights on the lower end of the rope and a spring balance at the upper end. A Harding counter for ascertaining the number of revolutions was employed, and analyses of the coal gas were made by Mr. G. N. Huntly, who also supervised the analyses of the exhaust gas. The results of seventeen preliminary experiments made were given in a table contained in the report, and on copies of indicator diagrams attached. The mechanical efficiency of the engine varied from 76 to 84 per cent., the mean value of the whole seventeen tests being 81 per cent. It must be remembered, however, that these experiments are, as stated, preliminary, and, it may be eadded, they have been carried out under circumstances of exceptional difficulty, which conditions, however, will not recur. The report states that it would seem probable that the influence of increased compression on economy is due to the fact that weaker charges can be burnt completely during the stroke when the compression is high. The tests seem to indicate, the report continues, that economy depends on the choice of the correct ratio of air to gas; and this ratio increases with the compression. The number of experiments, however, are, as the report states, not yet sufficient to determine what this ratio is for any given compression. It is intended to make a series of tests sufficient for determining this important point. Further experiments are to be made at a constant speed; the variables being the load, the ratio of air to gas, and the compression. It is stated that, so far as these additional experiments have been carried, the first results have been borne out in regard to the advantage of using a suitable mixture, and in showing the importance of making an accurate analysis of the exhaust gases.

The discussion which took place on the presentation of the report did not add materially to information on the subject. Some of the criticisms were very wide of the mark, more especially in regard to one point, upon which much stress was laid, viz., the leakage of gas through the indicator. This was supposed by some speakers to be sufficient to vitiate the value of the experiments, but, according to Prof. Burstall's tests, made in order to elucidate this point, the consumption of gas by the indicator was so minute as to be imperceptible. It was stated during the discussion by Mr. Burstall, a brother of the author, that, according to calculation, if diagrams were taken every five minutes, when running at 200 revolutions, and if the whole of the gas escaped on the stroke, the loss would be one-fiftieth of 1 per cent.

To Remove Rust from Steel or Iron Articles.—The Suddeutsche Apotheker Zeitung says that this is easiest and best achieved by rubbing the article with a woolen rag carrying a mixture of 1 part of lactic acid and 2 parts of oil of spike. Let remain overnight, and next day rub with oil of spike alone. The rust easily rubs off, leaving the article clean as far as this feature is concerned. To restore the polish of the article, rub with the finest emery cloth, afterward with rouge cloth, and finishing with oxide of tin (tin litharge).

TAPERED HOLE WIDENING MACHINE.

WE illustrate a tapered hole widening machine patented and manufactured by Messrs. Walker Brothers & Company, 44 Constitution Street, Leith, and designed specially to take the place of the ordinary reamer used in widening holes by hand in couplings of propelier shafting. Fig. 1 gives a general view, the others illustrate details. The main principle is that the spindle runs in an eccentric bush at the end of the machine to the right of the engraving, and works as a ball and socket joint at the other end; the taper required being fixed by the eccentricity of the brass bush, which, attached to the spindle by means of a key, revolves in an iron bearing. The cutting tool is fixed in a hole in the spindle. The spindle is in two parts, as shown specially by Fig. 2, and thus may be disconnected to allow the coupling to be placed in position as in the general view. It is joined by means of a tapered pin, *F*. The end of the spindle, *L*, slides out and in, while the other end is fixed. The bearings or blocks, *A A*, are part of the framework, and to the end of the spindle marked *L* there is fixed by means of a key, *J*, the eccentric brass bush, *B*, which works in the iron block or bearing, *A*. The ball bearing, *K*, works in a brass bush, *C*, and allows the spindle to work freely. The taper required is, as we have said, fixed by the eccentricity of the hole in the brass bush, *B*, and as engineering works have usually two or three different tapers with which they work, they would keep in stock two or three sets of brass bushes to suit. The toothed pinion wheel, *G*, is geared to the driving spindle, which is driven by a belt and pulley at the back of the machine. The cutting tool, *H*, is fixed by a small cotter or feather. The machine illustrated has automatic feed and is capable of widening holes in couplings 9 inches to 20 inches in diameter. The work can be done more accurately and in less time than by the old method; the holes in the coupling when finished have all the same taper, so that the bolts require little or no fitting after being turned in the lathe, and there being no tapered reamers used, the trouble arising from these breaking is entirely obviated.—Engineering.



POWER REQUIRED FOR DRIVING VEHICLES.

SOME interesting tests have recently been undertaken in France with regard to the power required for the propulsion of vehicles, fitted with wheels with ordinary iron rims and pneumatic-tired wheels, and the results showed a marked all-round advantage by the pneumatic wheels. A table of the pull required, reduced to kilogrammes, shows the results with different roads and different loads:

	Iron Rims. Kilog.	Pneumatic Tires. Kilog.
SNOW.		
Empty vehicle, walking	17·80	11·45
Empty vehicle, trotting	29·60	15·27
150-kilogramme load, walking	17·83	12·71
150-kilogramme load, trotting	31·17	17·96
WET ROADS.		
Empty vehicle, walking	16·00	10·50
Empty vehicle, trotting	19·55	12·97
150-kilogramme load, walking	17·30	12·43
150-kilogramme load, trotting	23·00	14·16
NEW AND DUSTY ROADS.		
Empty vehicle, walking	17·43	14·05
Empty vehicle, trotting	20·41	15·95
300-kilogramme load, walking	20·75	19·14
300-kilogramme load, trotting	29·70	16·40

Experiments were also made with various pressures in the tires—3 and 4½ atmospheres—but there did not seem to be much difference between the two.

LOVE JOUSTS AMONG THE GROUSE.

By Dr. G. ARCHIE STOCKWELL, F.Z.S.

THE advent of spring with its wealth of bloom and verdure is the signal for an universal burst of melody from orchard and hedgerow, forest and meadow, for it is the period of wooing among the feathered tribes. The males are now at their best, both as regards voice and plumage, and they vie one with another in display of those charms that are inherent to race and species. Those of sober dress and more modest mien court their mistresses by soft and fervid notes; others, less gifted, seek to display their gallantry and gorgeous apparel; while others, again, denied both gift of song and dazzling attire, are endowed with special forms of ornamentation, partly musical, perhaps, but certainly supplemental to demeanor and carriage, specifically calculated to awaken passion and desire within the female breast. Old Bonabbon taught better than he knew when the assurance was given Prince Ahmed that "Love is the cause of half the ills of wretched mortality;" for, absolutely, in none of the walks of animal existence is the consummation of the "tender passion" effected without more or less of heart burnings and strife. Especially is this true of the gallinaceous birds, among whom love is little else than a synonym for lust and successions of jealous bickerings.

The domestication of centuries has failed to wholly eradicate from the barnyard cock the attributes of the jungle fowl of India, in that he still with strident notes awakens his harem at dawn to do him homage and witness those exhibitions of pride and arrogance whereby he seeks to secure their fealty. So, too, the turkey gobbler, true to a lineage derived from Mexican coverts, with expanded tail, lowered and buzzing wings, turgid wattles, neck drawn back and erected head, parades before his seraglio and with loud, sonorous "gobble" calls attention to the grandeur of his metallic plumage as it glistens in the sun.

But it is among the grouse that these gallinaceous characteristics reach their acme, and here they may be studied to best advantage; and the modes of wooing, though somewhat diverse, according to species, nevertheless give evidence of common origin. Grouse courtships, however, present two phases, which for convenience may be denominated respectively solitary and gregarious, though it is not uncommon to find both exhibited by the selfsame species on occasion, or with changes in surroundings or habitat, or new phases of existence as enforced by circumstances.

Solitary wooers, owing to peculiarities of vocalization, produce peculiar half-muffled and ventriloquial notes that at first, perhaps, are uttered in staccato measure, but rapidly blend until one continuous sound results. This is vulgarly denominated "drumming," and the *Bonasa umbellus*, ruffed grouse ("partridge" in northern districts, "pheasant" south of Pennsylvania), common to the greater part of temperate North America, is typical of this class, as is also its relative, *Bonasa sylvestris*, of Northern Europe.

Gregarious wooers, in general, are recognized by an extraordinary supplemental development of the vocal apparatus, specially manifest at the breeding period, whereby is produced the peculiar notes that are uttered only when the individual male is seized with the rage of concupiscence; it is the peculiarities of these notes that have won for this class of Gallinaceæ the pseudonym of "boomers." To be sure, a differentiation of grouse by the titles of "drummers" and "boomers" is by no means exact or proper, but may be accepted in this instance as affording a ready means of description; again, as will be shown later on, the so-called "drummers" are by no means wholly lacking in the peculiarities that are popularly held to obtain solely to the "boomers." The true prairie or heath hen and the dusky grouse of Oregon (*Cupidonia cupido* and *Dendragapus obscurus*) are probably the best representatives of the latter class.

The supplementary apparatus of the "boomer," to all intents and purposes, is the analogue of the complex apparatus, known as wattles in the male turkey, but is much more simple. In the latter the rolling note is seemingly produced by a series of explosions from the oral terminus of the wattles, the convolutions serving the purposes of valves, and dividing the apparatus, when in active use, into a series of separate compartments. In the grouse there are really two compartments—sacs or pouches—one on either side of the under portion of the neck close to the head, and communicating, not with the windpipe as would naturally be imagined, but with the mouth direct. In the normal condition of the bird, these sacs are practically or wholly invisible, being concealed by a ruff of somewhat luxuriant plumage, and when detected appear merely as patches of bare, wrinkled, semi-scaly integument; but when distended—stimulated to vocal activity—they assume a spherical form, with more or less tendency to ovoid. They are of a glistening, dusky red, or reddish-yellow hue, according to the degree of erethism manifested, the size of one's closed fist, perhaps, and bear some slight resemblance to coarse red-skinned oranges, with which, indeed, they are usually compared; also vary in size according to species, age, and degree of sexual excitement, and in capacity from two ounces in the smaller birds to four, six, and, in some rare instances, ten ounces in the larger. The location, form, and size may be demonstrated upon the dead grouse by putting the bill upon the stretch in the same way as in the natural act of gaping, and lifting the tongue from its resting place between the two sides of the lower mandible, when the oval orifice (or orifices, for, on rare occasions, there are two) is revealed, lying just in front of the upper larynx between the latter and the sub-mandibular, deep, and cutaneous tissues; now, by inserting a fine hollow probe or blowpipe into the opening, the sacs may be distended to their full capacity; or by a few trials and a little knack, they may be inflated by inserting the bill of the bird in the mouth and blowing, the creature being supported solely by the head, the weight of the pendent body serving to effectually close the windpipe and lower pharynx.

Examining the inner surface of the gular sacs, they are found to be lined simply with mucous membrane derived by proliferation from the folds of the same that pertains to the mouth and upper pharynx; this membrane is separated from the outer integument by a layer of vascular, erectile tissue, that everywhere exhibits the complex ramifications of capillary vessels and nerve fibrils, both so minutely and intimately interwoven as to resemble fine network. The nerve fibrils may be traced directly to the ganglia that control the sexual system. There are also some sparse, striated muscular fibers mingled with and overlying the capillary and nerve network.

Beyond their purpose in aiding to secure the affections of the opposite sex, these gular appendages appear to possess no especial significance; their loss jeopardizes neither physical or sexual vigor in any way, other than as the removal of a mammary gland might affect the human female; they are frequently destroyed as the sequel to jealous strife, or by affording shelter and sustenance to certain larval forms of life (parasites), with the exit of which inflammatory conditions develop that entirely deprive them of their lumen.

Strange to say, this form of gular development was long regarded as mysterious, the palpable relation to sexuality being overlooked or wholly ignored; and some most stupid and far-fetched ideas were formulated that, as regards certain species, have not yet entirely lost influence. One theory advanced was that these sacs subserve a purpose analogous to the reticulated portion of the compound stomach of the camel; and to this day it is not uncommon to find the pouch of the common cock bustard of Europe (*Otis tarda*) described as "An admirable magazine provided by nature against drouth, capable of holding six quarts (?) of water," or to read that it is "filled on proper occasions to supply the demands of the female bird while engaged upon the nest in the duties of incubation, or the young before they are sufficiently developed to use their limbs."* It was not until the zoological world became fully cognizant of the fact that habits of life are essential concomitants to habitat and surroundings, that habitat has a distinct purpose in nature, and finally obtained some real insight into the habits and peculiarities of existence obtaining to the pinnated grouse (*Cupido cupidonia*) or "heath hen" (true "prairie chicken"), which is of this selfsame class, that even an inkling was obtained of the real truth, and as already hinted, the world is still, apparently, very loath to substitute fiction by fact. Birds of this class, be it known, are exceedingly sparing in the use of fluids, and often do not partake of them at all if they are only available in the ordinary way. They are accustomed to encounter long periods of drouth successfully, and when they do seek to quench thirst, it is invariably by means of rain globules or drops of dew gathered from off the ground and herbage.

Again, the dual form of gular apparatus that is held to be peculiar exclusively to certain forms of American grouse, in fact is, in greater or less degree, common to all Gallinaceæ. Traces thereof are to be found even in bustards; in many species, as with the turkey, it is appartamental rather than dual; and when apparently single it will often reveal traces of a septum. Indeed, it is only in the more rudimentary forms of development that duality is sharply defined, and isolation of the sacs complete, as in the black cock (*Tetrao tetrix*) of Europe, and the ruffed grouse (*Bonasa umbellus*) of America, in both of which the gulars are little if any larger than a filbert or small almond, hidden beneath an erectile ruff, and generally assumed to be non-existent. Evidences of pouches, also, are not lacking in female birds, but here rarely assume appreciable development, and when they do so develop, are justly held to be the physical manifestations of an inverted or bisexual instinct and probably accompanied by inability to fœcundate or ovulate.

In early spring, even as early as February in some localities, in others so late as May, the plains and coppices affected by pinnated grouse or, to give their popular designation, "prairie hens," resound at early dawn with the notes of amorous, excited, and belligerent males; the same may sometimes be heard, also, for a brief period, during the evening, just as the sun has sunk below the western horizon. At such times the cocks gather for the purpose, apparently, of commending themselves to the favors of the opposite sex. These love notes constitute the "tooting," "tooling," or "booming," as the act is variedly known, and, when many birds are concerned, has a peculiar continuous rolling sound, though the individual utterances consist of but three accented notes, two of which are of equal length, the third doubly prolonged. The sound is likened by Wilson to "the voice of the night hawk in descending flight;" by Parker Gillmore to "the lowing of cattle;" by Mitchell to the "sound of horn or conch;" and by others to "low muttering thunder" and to "distant crowing." In truth, it is utterly beyond descriptive or imaginative powers, first because it varies according to conditions of atmosphere and surroundings, and, second, it is especially modified, and often enhanced, where there is any tendency to reflection or echo. Its cadence is slow, solemn, and muffled, yet resonant, if such combination can be imagined; rising and falling in the still air of the early morning, it simulates nothing but itself, and must be heard to be appreciated; and, once heard, will never afterward be mistaken for anything else. The fact that it never reaches the ear twice precisely alike doubtless accounts for the various inharmonious and conflicting descriptions. Sometimes loud, full, and sharply defined, apparently at one's very feet, it is found to emanate from some covert or coppice half a mile away; again the performers are sought for at a distance, when in reality they are close at hand.

From the exceedingly early hour at which these morning concerts begin, often long before dawn in the height of the courting season, it has been surmised that the cocks assemble overnight; and this is absolutely the case in some, but not in all, instances. It seems to be governed chiefly by caprice or by a superabundance of male birds. Cocks have been observed at the "tooling ground," or "scratching place" as it is sometimes designated, at one and two o'clock in the morning; Mitchell found a number assembled at midnight; and from personal observations I am led to believe it is not an uncommon occurrence for a number to roost upon the ground, perhaps as the sequel of an evening tournament. On dispersing a gathering, I have repeatedly found such an abundance of fresh excrement, lying in rings and circles, as to give evidence of a considerable assemblage huddled together for hours, after the manner of the grouse kind when seeking mutual protection and warmth. I am inclined to believe, also, that it is the younger birds, the yearling cocks, that for the most part "tool" in the evening, and that they assemble overnight in an attempt to supplant and forestall their elders. That all cocks do not thus gather is apparent from the fact that just at dawn close observation will reveal isolated males coming from all directions, both on wing and afoot, and they are readily differentiated from the youngsters and those of the opposite sex, not alone by the prominence of their wattles and distinctive markings, but by the openness and boldness of their approach. The immature or yearling males, and the hens especially, are prone to skulk through the herbage, taking advantage of every opportunity for concealment, as if desirous of eluding observation.

Commonly the "ball" opens just as the first pencil of rosy light shoots toward the zenith, though before this isolated sounds may be heard that usually are promptly checked and hushed. The proceedings, perhaps, are ushered in by a loud, prolonged note from some impatient champion, quickly taken up and echoed by another and another, until it swells in full chorus; and now cock after cock, swollen with pride and lust, with turgid wattles, feathers reversed, wings buzzing, tails upset, necks incurvated, and a general appearance of being turned upside down, or inside out, strut into the open space that constitutes the theater of their jousts. Hither and thither they go with gulars continually inflating and collapsing, to the music of their own pipes, affording a scene of most remarkable ostentation and arrogance. Faster and faster are the movements, wilder and higher the weird sounds, until all semblance to individual notes is lost in the universal continuous "booming." A few, perhaps, remain motionless in half-squatting position upon the ground, paying little attention apparently to the general *rout*, but still are monotonously engaged in piping. Some singly, in pairs, or in bunches, race hither and thither, creating a wondrous maze of figures, even circles, ellipses, and ovals; some with dizzy whirlings fairly emulate the movements of so-called "Japanese waltzing mice," though they are less spry and graceful; and the majority are more or less engaged buzzing wings along the ground, flaunting elongated neck plumes and cocked-up tails, scolding, cackling, and "tooling." It is a very threatening performance, each seemingly seeking a combat which at the last moment he appears equally anxious to avoid; it is, in fact, a remarkable display of fuss, feathers, and sound, beside which the parades of the turkey cock fairly pale.

After a time, however, some cock leaps in air, perhaps a foot or more, with multitudinous flutterings and defiant cackles, producing a series of cachinnations resembling nothing so much as the half-smothered giggles and suppressed laughter of a school girl, and the whimsical ludicrousness thereof is almost enough to tempt the human observer to sympathetic mirth. But, like all that has gone before, this is mere show and pretense; one of the preliminaries intended for the delectation of the other sex who, concealed near by, doubtless glory in the grandeur of their lords and paramours, and derive therefrom the enjoyments peculiar to the weaknesses of femininity. And who knows how far bright and glistening eyes may serve to excite these lovers to doughty deeds of daring, as well as of display; or who shall define the gratification the female heart derives from the tourneys of those who are rivals for its affection and constancy!

Ultimately, some fair wanton, doubtless overcome by the fascinations of an agile admirer, drops all pretense of shrinking modesty, and gives utterance to a soft and alluring note, intended, perhaps, as a measure of applause and encouragement, perhaps possessed of more tender significance, but that, in any event, works a sudden transformation. As if it were a long expected and preconcerted signal, the cocks now fall foul one of another indiscriminately, exhibiting all the fury of little demons, looking at nothing, caring for less; all are bitter foes, and each is eager to wreak vengeance upon every and any male of his race. Leaping in air, pecking, biting, clawing, tugging, riving, and buffeting, the favors of rage and jealousy are bestowed blindly and without definite measure or purpose on all sides. Here two or three make an onslaught upon a single foe, but, almost instantly, the scales are balanced by the freedom with which blows are miscellaneously bestowed, and who is who in the fray is a problem beyond the ken of mortal man. Again is seen a couple with lowered heads, distended gulars, upset plumage and hackles, revolving around a common axis, warily eyeing each other, after the manner of practiced duelists, apparently intent upon settling their dispute according to the approved rules of the cock-pit, but being suddenly jostled by some unfortunate wight, they turn upon him and force a retreat, thereby themselves becoming mixed up in the common melé. For once a number may forget their differences long enough to drive an unfortunate to seek refuge in the coverts—by no means a fate to be deplored. This is especially apt to accrue to the one who ventures to run "amok." As a whole, it is a brisk, spiteful, miscellaneous conflict, conducted without fear or favor, and without system; and it continues until all are exhausted—possibly to be resumed again. But, if the sun has got well up, they are apt to disperse to seek the fruits of labor and display.

Neither are the prizes always for the strong, since sex has its prerogatives, and the female is often more ready to reward the astute than the brave, and, frequently, when the tourney is at its height, the older cocks may be observed to separate themselves from the throng, sneak into the coverts, only to emerge a little later on the opposite side, each with a number of hens at his tail that, doubtless, afford ample amends for any loss of honor or wounded *amour propre*.

Many decline to believe these jousts are other than mere forms calculated to display the vanities of the male sex to the best advantage; but this is only partially true. Though serious and fatal results rarely accrue, they do sometimes occur. Birds that have lost an eye, or whose gulars are punctured or bleeding, have been observed, and even dead and dying are sometimes left upon the field. A handful of feathers is always to be had. The real conflict, however, it may be surmised, is sustained chiefly, if not wholly, by the younger and less experienced cocks, while the oldsters reap all the fruits of a real victory.

The "drummers," such as the ruffed grouse, are scarcely at all gregarious in the breeding season, and

* Vide Gould, Buffon, Goodrich, Wood, and other popular authors.

only assemble in packs in autumn, though they are usually as polygamous as the "boomers." The jousts of the males, too, are individual in character—partake more of the nature of the conflicts of barnyard fowl—and the battles are frequently fierce and prolonged. The male, selecting some slight elevation, perhaps nothing more than a small rock or mound—I have known a very small stick to answer his purpose, though he often seeks a log—proceeds to inflate his little body until it seems twice its natural size, then, assuming much the same position as his pinnated relative, he proceeds to give utterance to a long, rolling, drumming note. This is a challenge to all rivals, and likewise a signal to the hens to approach and witness his grandeur. The notes, at first broken, gradually become continuous, and now the movements of the wings are so rapid that his body seems to be surrounded by a halo.

How the ruffed grouse produces his note is a matter that has led to much unprofitable and acrimonious discussion. Some think it is the result of beating a log with the wings; but this is manifestly impossible, since the dust, bark, or moss beneath his feet are little if at all disturbed, and further, the sound is readily produced while the bird struts along the ground. Another view is that the body is actually inflated until it becomes resonant, and is then beaten by the pinions; but this is also untenable, because of size and defects in the pinions themselves. The most ridiculous theory ever advanced, however, is that the grouse drums by striking his wings together over his back—a feat that is anatomically impossible, to say nothing of other inherent absurdities. How far the gular sacs are involved has yet to be determined, but that they are in part inflated, and the erectile tissue thereof injected, would seem to be a fact, from the rigid way in which the protecting ruff of feathers stands out during the act. A further clew may be had, in part, perhaps, by observing the aërial love flights and drummings of the snipe and woodcock, with whom the sound is produced by dropping from a height and allowing the wing feathers to become rigid, they being also set at an angle whereby each becomes, as it were, the string of an Æolian harp. Doubtless the sounds produced by the grouse are of Æolian character, for they are also ventriloquial, and may be reinforced by the rapid compression under the wings of air, and its alternate expulsion, thereby producing a form of explosion—such an act may be witnessed, accompanied by a sharp "spiff" and also a drumming sound, in the male turkey when he parades before the members of his harem. Again, the Canada, wood, or spruce grouse (*Canace canadensis*) drums very much like his ruffed relative, in so far as sounds go, but the act is quite different; the sounds are heard only when he is dropping from a tree to the ground, but, during this maneuver, his wings accentuate a halo about his body. And no game bantam is more fierce than this little forester, who even attacks the lord of the games in the barnyard on occasion, and positively never comes off second best; and the domestic turkey cock is even more quickly put to flight. If stupid from the sportsman's view, he certainly is quite the reverse from the standpoint of those addicted to the attractions afforded by the cockpit, and to this, this bird might prove a novel and valuable addition. But then he battles in his own way, and strikes and buffets and pecks while in mid-air, using his wings with a degree of freedom unknown to any form of domestic fowl.

That these displays, whether of a solitary character, as with the ruffed grouse, or partaking of the nature of general jousts or tourneys as with some other species, are the outcome solely of concupiscence and lust, no longer admits of even a shadow of doubt, and they obtain only for a brief period during the vernal season. When grouse are heard "booming" or "drumming" in late autumn, as is sometimes the case, the sounds proceed from the three-quarter grown males of that season's brood; they have but just completed the period of adolescence, so to speak, and for the first time are overtaken by the knowledge that nature has implanted in each a most powerful passion.

All grouse are pretty much alike in their loves. Neither sex is at all constant, but attentions and favors are bestowed and received in a most promiscuous manner from day to day, even from hour to hour, as occasion or preference may dictate, being limited only by the strength and acumen of individual and masterful males. The salacity, too, of both cocks and hens is beyond all computation or measurement, and the latter, as frequently as not, during the middle of the day, become the solicitors as well as the solicited. And when the female is laying, it is no uncommon occurrence for the males to destroy the eggs, manifestly with the purpose of prolonging the courting season. Save when enforced by circumstances and surroundings, there is not, apparently, the least approach to monogamy, and the race presents none of the charms of domesticity and faithfulness, even to sharing the duties of incubation and feeding the young, that are so conspicuous among the partridge family, and that reach the acme of perfection in the English perdix and American colin ("quail"), and are not even exceeded, and seldom equaled, even among the highest order of bipeds.

Again, save in regions where groves and wooded coverts abound, pinnated and other "booming" grouse do not gather in any numbers for the purpose of competing for the favors of the other sex. Time was when this was different, but the gradual extinction of the species to the eastward, and a tendency to follow, or perhaps precede, the westward march of civilization, have worked many changes and transformations as regards habits. In a purely prairie country I have never seen more than a half-score or a dozen cocks in the same precise neighborhood during the breeding season, or even heard their characteristic notes in a way that would suggest an assemblage of a greater number. I do not now refer to the sharp-tailed grouse which is in some localities denominated "prairie hen" and "prairie chicken," nor to the hybrids of sharp-tailed and pinnated grouse. Here, too, individual conflicts are more often the rule than the exception, the same as with the ruffed grouse; and once I witnessed a battle near midday that began upon a fence of rails and ended on the ground, wherein the combatants exhibited all the courage, stubbornness, and vindictiveness of two game-cocks, evidently with the view of determining lordship over three hens hidden in the clover, that I subsequently flushed. Careful beating of the ground for a considerable area around failed to reveal any others of the species.

The gulars of *Centrocercus urophasianus*, the sage grouse, sometimes denominated "plains turkey," because of its size, which approaches closely that of the capercailzie of upper Scandinavia (*Tetrao urogallus*), are capable of considerable greater distension than those of any other species. Though these appendages are frequently described as being, when fully inflated, of half the dimensions of the bird, in reality they do not exceed a golden pippin, or large apple or orange, and they also bear some resemblance to the latter, but are of rather darker or deeper hue, if anything, more of a dusky red, besides being of irregular form. During the love season the male mounts any convenient knoll, tussock, or hillock, and vociferates his rolling note, at the same time reversing plumage, lowering wings, and parading after the manner of the grouse kind, though with hardly so much show and vigor as is exhibited by his smaller cousins. He, moreover, is inclined to be solitary in habit, and as few cocks are ever encountered together, conflicts, save of a personal character, are comparatively infrequent. Dr. Newberry describes the love note as a deep and hollow "'*hurr-hurr-ooo-hoo*,' like the sound produced in a large reed by blowing at its open end;" at the same instant the neck feathers and wings become stiffened, the latter buzzing along the ground; the tail feathers are elevated and spread out like a fan; and the bird executes a variety of grotesque and amazing attitudes, all with the view, of course, of securing the affections of one or more of the opposite sex, presumably hidden in the herbage close by.

Though this species is polygamous by nature, yet monogamous attachments are frequent—are really enforced by circumstances—in many portions of its habitat. A notable fact regarding this form is, though it is now known as "sage grouse" and "plains turkey," and the popular works devoted to ornithology and natural history recognize it only as a denizen of the prairies and of treeless wastes, it was formerly an inhabitant of the wooded districts of the upper Canadian River and the head waters of the Arkansas; and from its custom of perching in trees, a habit long forgotten, apparently, it was by the French *coureurs de bois* and trappers denominated *coq de bois* or "cock of the woods." George Ruxton, in his "Mexico and Rocky Mountains," gives an excellent description of the bird under this title, one not to be mistaken, and states he found it abundantly in the regions just mentioned (a fact that seems to have escaped the observation of writers generally) and shot numbers from their perches on the trees. But the events of the last half century, and more, have not been at all conducive to the preservation of this naturally shy and retiring species; it has been steadily driven northward and westward, even forced over the Canadian border, entailing habits and modes of life utterly at variance with its original character. It is now chiefly found on the plains of Central North, and Southern British, America, where it was absolutely unknown fifty years ago, but nowhere numerous or abundant; indeed these grand birds are rapidly disappearing off the face of the earth, and soon, like the bison, will be little more than a remembrance. It would be interesting to know if any anatomical and physiological changes have been brought about by such radical changes in habits and habitat, which presumably also include changes in food. Notably the species is devoid of the hard muscular grinding stomach denominated a "gizzard," that obtains to other Gallinaceæ, its place being usurped by a fleshy bag approximating more nearly to the stomach of carnivorous feeders. As a woodland bird the sage cock certainly did not feed almost exclusively on grasshoppers, foliage, and herbage, as is now its habit, but upon the seeds of grasses and wild fruits.

The dusky or Oregon grouse (*Dendragapus obscurus*, and varieties *fuliginosus* and *richardsonii*) presents many of the characteristics, past and present, of the foregoing species, though his methods of courtship are peculiarly his own. Beyond the great range of mountains that divide the Atlantic and Pacific watersheds, the lower branches of a spruce, fir, or other evergreen tree are selected as points from which to display his splendor and deliver his love song, which assumes a muffled tone, with hooting somewhat owl-like, notes that have been compared to "*woo-woo-ooff-ff*," and that, even when coming from overhead, appear to proceed from some remote nook or aisle of the forest. Though possessed of a decidedly Quakerish garb, at such moments the little fellow becomes really superb, as with flashing eyes, erected feathers, and inflated gulars of copper golden hue, he paces backward and forward displaying the metallic graces of his plumage; he well deserves the title of "cock-of-the-woods" that has been bestowed upon him by the dwellers in British Columbia and Oregon. On the hither side of the Rockies, however, while retaining all the conceit and arrogance of the race, this bird has lost many of the characteristics peculiar to dwellers of the forest, assimilating more nearly to those of the grouse of the plains. Here it frequents both grove and prairie, as accident or circumstances may dictate; it sometimes mingles with the sharp-tailed grouse (*Pediœctes phasianellus* and variety *columbianus*) and mesalliances are not infrequent; and it is here only that a tendency to gregarious courtships becomes at all marked.

One morning in June, when encamped with a Hudson's Bay "brigade" upon North River, in the upper and northern Saskatchewan region, now the Athabasca district, I was awakened at early dawn by a booming note, at first imagined to be the drumming of a ruffed grouse, but that speedily developed many unfamiliar phases. It did not appear to be specially loud, but dense as it were, and continuous, as though produced by a number of performers. Suspecting it might be the love song of the dusky grouse, and desiring a few birds to eke out a somewhat restricted diet, composed chiefly of "three-water" tea and mouldy pemmican, I seized my gun and stole silently into a grove of Scotch firs just as the last note died away. After half an hour of fruitless search, during which the sound was thrice repeated at considerable intervals, and, as I was about to give up the task, suddenly, a little way to the left, a grouse was observed to drop from a tree into an open space near the river. Approaching quietly, in an attempt to stalk it—for hunger in the wilderness is not at all conducive to sportsmanlike methods — to my astonishment some thirty or forty birds were discovered assembled in the little glade, the dry and trampled grass affording abundant evidences of the uses to which it had been put. All were males, as could easily be determined by the half-expanded gulars; and the majority were engaged in stalking about in slow and stately fashion, apparently with no especial purpose in view. They were no longer "booming," but occasionally gave utterance to little soft twitters and clucks—after the manner of the barnyard bantam hen when followed by a brood and out in search for food—alternated with formal little flutters and twirls that markedly resembled the stiff waltzing automatons of an old-fashioned Swiss barrel organ. So intent were they on the business in hand, or that yet to come before the assemblage, that I had little difficulty in disposing of myself in a way to view their maneuvers to advantage.

Soon the parade ceased, the performers standing stiff and motionless, save each had a slight, up and down teetering, and backward and forward swaying movement. Each head also was drawn back to meet the forward inclination of the tail, and turned slightly to one side as if listening, or awaiting some move or signal.

Presently, an old cock, as I presumed him to be from his more ashen plumage, strode toward the center of the glade, and after regarding the assemblage profoundly for a couple of seconds, flung himself violently a full yard or more into the air, returning to the earth again with gulars fully distended, and pouring forth an intense volume of rolling sound, that was instantly taken up and echoed on every side. For the first time I was able, with good light, to note certain peculiarities that I now know are more or less common to all "booming" songsters and which are in some degree imitated by the ruffed grouse and others of the "drummers." While the notes are being produced, and at their fullest, the head is elevated—really tilted back—the mandibles fully agape, until the oral space is practically continuous with the larynx, all forming one straight tube, and there is marked play of the muscles of the neck and upper thorax occurring coincidently, or perhaps alternately, with the vibrations of the hackles and air sacs. And now it was manifest the inflation of the body, that has been observed by many, is apparent rather than real, the deception being due to a muscular act whereby the movements of the wings and the gular sounds are controlled, the latter aided in part, perhaps, by movements of the tongue and mandibles.

After another leap, the self-constituted leader began racing backward and forward; then paused to again utter his peculiar notes, beating an accompaniment thereto with his wings; meantime his followers moved about rapidly in the circumference of a circle of which he was the center or pivot, all turning, twisting, and skipping, only pausing now and then to trumpet forth the full power of their "tooting," or for queer lateral rushes as if giving challenge, or perhaps as mere play since they failed to lead to any result. It was a grotesque dance at best, lacking everything that might be termed "poetry of motion," being devoid of rhythm or measure, partaking rather of a haphazard, crazy scramble. At no time were all engaged in "tooting" or "booming," and at least partial rest appeared to be essential to the full consummation of the act by means of which the sounds were produced; but while running, a steady low-keyed note filled the air, almost exactly resembling the distant "drone" of the Highland pipes, and that, moreover, was highly ventriloquial, for though the birds were less than three yards from my place of concealment, as often as otherwise it appeared to proceed from overhead, or from over across the stream, the latter delusion, doubtless, being aided by waves of sound reflected from the high bluff that constituted the opposite shore. I imagined then, and since have had no reason to modify this view, that the gular sacs played no part in the production of the "drone"—for so I must term it—but that it proceeded wholly from the rapid vibrations of the wings. It was certainly a strange and unique performance, being utterly unlike anything of the sort I have ever witnessed, before or since, and with only a partial resemblance to the "dances" of other grouse.

Three times these performances were repeated, each, if possible, more wild and extravagant than the one preceding, until even dancing or whirling dervishes could scarce have executed more varied, rapid, or complex evolutions and tumblifications. Here and there birds ran in and out among their fellows, crossed and recrossed, advanced and retired, all the time executing odd little jerks and flirts with their cocked-up tails, incidentally creating mazy figures, not altogether unlike those of a ball room; and one can consequently readily conceive why these gatherings are, by the fur-traders, *couriers de bois*, *voyageurs*, and Hudson's Bay men generally, denominated "partridge dances."

The oldster, who acted as chief precentor or master of ceremonies, evidently thought no "small beer" of himself, for he would inflate his gulars almost to the point of bursting, and pour forth his notes with *allegresse* and energy most surprising in a creature whose weight could not exceed a couple of dozen ounces at most; and when he ceased, silence fell upon the entire assemblage, the "pipes" being suppressed one by one, until all were as mute and motionless as so many wooden decoys. At the third pause, which was somewhat prolonged, prompted doubtless by impatience, or perhaps seeking glory and renown, a youngster suddenly sprang in mid-air, giving utterance to the wonted signal. Faintly echoed by one or two, he essayed it again, only to bring down upon himself the wrath of outraged dignity in the person of the true leader. With a rush and shrill cluck, the latter singled out the rebel and proceeded to administer to him a most unmerciful drubbing, employing bill, wings, and claws; and I expected nothing else but a general fray, but somehow the others seemed content to remain mere spectators, and appeared also to regard this bit of diversion as quite a matter in course. The little fellow fought hard and well, but he was handicapped from the very outset by might and experience. Twice he was "sent to grass," and twice again faced his foe bravely and handsomely; then followed a rough-and-tumble and all-round scrimmage, in which neither of the participants could be identified, and that culminated, by the little one turning tail and scurrying into the nearest covert, meantime vociferously plead-

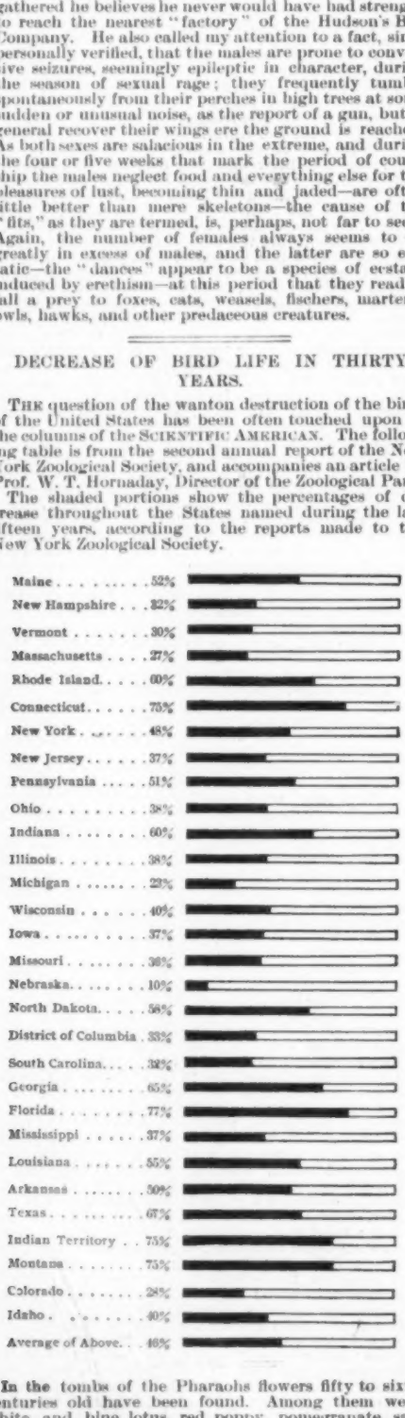
ing for mercy, for he was pursued to the very edge of the cleared arena by his implacable opponent. So chopfallen and discomforted was he that he passed within a few inches of my face utterly unaware of my presence, until I reached forth, seized him by the neck, and "gathered to his fathers;" for by this time I was becoming painfully aware of the cravings of appetite, and, moreover, a signal had been just fired for my recall. His flutterings, which from the position I was in could not be altogether repressed, alarmed the gathering, and I hastened to knock over half a score by pouring in upon them the contents of both barrels of my gun, the remainder taking to the tree tops, whence little difficulty was had in securing four and a half brace more, in spite of their remarkable resemblance, when perching, to tree knots and protuberances; but on my return to camp, I was surprised to find nine of the birds were hens, doubtless those shot from the trees, and that met their fate by virtue of having been spectators. They must have been flushed with the cocks, or else were previously ensconced in the trees.

On relating the events of the morning to an intelligent Scotch half-breed, he assured me he had witnessed many "dances," and though often prolonged for hours if not molested, he had never known one to break up without a general scrimmage. More than once he had, as he claimed, walked into the midst of the excited throng and seized and wrung the necks of a couple of valiant cocks ere the wrath of the assemblage had cooled sufficiently to lead them to seek safety in flight. On another occasion he thus disturbed a dance at midnight of a moonlit night on the upper Mackenzie, which was a veritable godsend, as, by an upset from his canoe, he had lost gun, ammunition, and provisions, and was at the point of starvation; but for the birds gathered he believes he never would have had strength to reach the nearest "factory" of the Hudson's Bay Company. He also called my attention to a fact, since personally verified, that the males are prone to convulsive seizures, seemingly epileptic in character, during the season of sexual rage; they frequently tumble spontaneously from their perches in high trees at some sudden or unusual noise, as the report of a gun, but in general recover their wings ere the ground is reached. As both sexes are salacious in the extreme, and during the four or five weeks that mark the period of courtship the males neglect food and everything else for the pleasures of lust, becoming thin and jaded—are often little better than mere skeletons—the cause of the "fits," as they are termed, is, perhaps, not far to seek. Again, the number of females always seems to be greatly in excess of males, and the latter are so ecstatic—the "dances" appear to be a species of ecstasy induced by erethism—at this period that they readily fall a prey to foxes, cats, weasels, fishers, martens, owls, hawks, and other predaceous creatures.

DECREASE OF BIRD LIFE IN THIRTY YEARS.

THE question of the wanton destruction of the birds of the United States has been often touched upon in the columns of the SCIENTIFIC AMERICAN. The following table is from the second annual report of the New York Zoological Society, and accompanies an article by Prof. W. T. Hornaday, Director of the Zoological Park.

The shaded portions show the percentages of decrease throughout the States named during the last fifteen years, according to the reports made to the New York Zoological Society.


Maine 52%
New Hampshire . . . 32%
Vermont 30%
Massachusetts 27%
Rhode Island. 60%
Connecticut. 75%
New York 48%
New Jersey 37%
Pennsylvania 51%
Ohio 38%
Indiana 60%
Illinois 38%
Michigan 23%
Wisconsin 40%
Iowa 37%
Missouri 36%
Nebraska. 10%
North Dakota. 56%
District of Columbia . 33%
South Carolina. 32%
Georgia 65%
Florida 77%
Mississippi 37%
Louisiana 55%
Arkansas 50%
Texas. 67%
Indian Territory . . 75%
Montana 75%
Colorado 28%
Idaho 40%
Average of Above. . . 46%

In the tombs of the Pharaohs flowers fifty to sixty centuries old have been found. Among them were white and blue lotus, red poppy, pomegranate, saffron, crocus, and chrysanthemum.—La Vie Scientifique.

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